OBJECT LESSONS IN GEOGRAPHY

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THE TEACHER'S MANUAL

OF

OBJECT LESSONS

IN

GEOGRAPHY

BY

VINCENT T. MURCHÉ, F.R.G.S.

HEADMASTER OF BOUNDARY LANE BOARD SCHOOL, CAMBERWELL

AUTHOR OF

'THE TEACHERS' MANUALS OF OBJECT LESSONS IN ELEMENTARY SCIENCE,' 'OBJECT LESSONS IN DOMESTIC ECONOMY,' 'OBJECT LESSONS FOR INFANTS,' 'OBJECT LESSONS IN ELEMENTARY SCIENCE AND GEOGRAPHY COMBINED,' 'OBJECT LESSONS FOR RURAL SCHOOLS,' 'SCIENCE READERS,' 'DOMESTIC SCIENCE READERS,' 'COMBINED READERS IN ELEMENTARY SCIENCE AND GEOGRAPHY,' 'NATURE KNOWLEDGE READERS,'

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PREFACE

THERE was "a good time coming" for the children, when the Education Department wisely determined to discourage, through H.M. Inspectors, the senseless repetition of lists of names and meaningless definitions, and in its place to foster the cultivation of intelligent teaching by the natural process of observation; and under the new regime there is every prospect that our little ones will now be educated in the best meaning of the word.

Surely every teacher in the land will agree that in no subject of the school curriculum was the change so badly needed, as in that all-important one—**geography**—more especially in **its earlier stages**, where the children repeated over and over again, *ad nauseam*, strange jumbles of words about capes, islands, gulfs, and mountains, all of which were illustrated by (to them) equally strange-looking figures, called plans, or maps, drawn on the upright black-board.

The natural result was that, however glibly they might rattle off these definitions to satisfy the inspector, it was but parrot-work at the best.

In the following lessons the author has endeavoured to lead the young children for whom they are intended, by a series of easy and natural stepping-stones, commencing with the observation of the simple, every-day pheno-

mena of earth, air, and water, and of the common things around them.

Thus, the child begins **by observation of the falling rain, the gutter streams, and roadside pools,** and these eventually become his natural teachers, which help him to form intelligent ideas of the formation of rivers and lakes.

The rain and what becomes of it forms, indeed, the key-note of much of the future teaching. The rain feeds the rivers; the rivers feed the sea. The rain even prevents the sea itself from getting salter and salter day by day.

Then, by a natural sequence, after dwelling on the blessings of the rain, the children are led to consider the Rainless Desert.

The map of England is introduced in sections by means of sand-models later on, and the child passes naturally to notice Scotland, the British Isles, and the mainland close by—and it is not till this stage is reached that **the name Continent** is mentioned.

During all this early part of the teaching, too, the long word, **Geography** (meaningless to a young child), **has been purposely kept in the back-ground.**

The word **Geography (earth-knowledge)—how it is learned**—and **its uses—form a fitting close to the whole,** when it is confidently felt that the child will be prepared to take up with zest and intelligence the study of some definite parts of the world—beginning, of course, with his own country.

Amongst other aims the Author has set himself the task of endeavouring to DO AWAY FOR EVER WITH THE RIDICULOUS AND ILLOGICAL PRACTICE OF DRAWING PLANS ON AN UPRIGHT BLACK-BOARD, than which nothing can be more confusing to the young mind.

The Manuals and Readers have been prepared in connection with the Author's New "Patented" Modelling Tray, Geographical Models and Apparatus, which (together with a series of forty Wall Pictures) are published by Messrs. A. Brown and Sons.

The lessons provide for teaching, with the aid of these prepared models and pictures, **for modelling in clay or damp sand**, and for **the drawing of all plans on the horizontal black-board, which forms part of the modelling tray itself.**

Not only these early plans, but **all the early maps are drawn on this horizontal black-board,** and hanging maps are not introduced till the children have, step by step, learned to grasp the full meaning of those drawn in the horizontal position.

STAGE I

PRELIMINARY LESSONS ON A FEW COMMON THINGS

LESSONS ON SIMPLE NATURAL PHENOMENA

SIMPLE OBSERVATION OF THE SURFACE OF THE LAND

LESSONS ON THE CARDINAL POINTS

LESSONS ON THE MEANING AND USE OF A MAP

STAGE II

LAND AND WATER

THE SAILORS ON THE SEA

LAND AND WATER AGAIN

SIMPLE LESSONS ON THE MAP OF ENGLAND

SIMPLE LESSONS ON THE SHAPE OF THE EARTH

THE EARTH AND ITS MOTIONS

THE SCHOOL GLOBE

PRELIMINARY LESSONS ON A FEW COMMON THINGS

Lesson I

WATER

Articles required for illustration: two small saucers, a basin, a tumbler, a small brush, a tray, a jug, a bottle, some saw-dust or sand, and a jug of water.

I. Introduction

Commence by calling attention to the water on the table. Lead the children to tell what they know about it.

This water came from the tap. We must have plenty of water every day of our lives. We drink it, and we use it to cook our food, and to wash ourselves, our clothes, and our houses.

Some of the children have probably seen the water of the sea, stretching out in front of them as far as their eyes could reach; most of them have seen the water of rivers, ponds, and ditches; all have seen water falling as rain, and standing in puddles in the roadway. Lead them to tell what they can of this.

Water is one of the common things of everyday life. It is one of the commonest things we see around us. We are now going to learn something about it.

II. Water flows

1. *Place two saucers on the table. Fill them to the brim very carefully—one with saw-dust, the other with water. Point*

out that the water and the saw-dust are both quite flat on the top, or level with the edge of the saucer.

Now bring a child to the front, and let him pile up more saw-dust, a handful at a time, in the first saucer, till he makes it stand in a big heap above the edge.

This done, call upon the class to notice what happens, when more water—only a very little—is put into the other saucer.

2. The water **will not stand up in a heap,** as the saw-dust does. Some of it runs away over the edge of the saucer, and spreads itself about on the table. The top of the water in the saucer still **remains flat or level.**

Make a pile of saw-dust on the table itself, or on a slate, and then try to do the same thing with water. Let the class tell what they observe.

The water again falls away, and **spreads about** over the slate.

3. *Explain that, because water spreads about in this way, we say* **it flows**; *and* **because it flows, we call it a liquid.**

Saw-dust does not flow; it is not a liquid. It will stand in a heap, just as it is now, till we take it away.

Call upon the children to name things that flow about like water, such as milk, tea, vinegar, ink, and oil.

These things cannot stand in a heap, as saw-dust does: they flow about.

Water, milk, tea, vinegar, ink, and **oil,** are all **liquids.**

4. *Point out that we* **cannot pick up water** *in our hands, as we pick up the other things on the table. We cannot even scoop it up as the boy did the saw-dust.*

It would **run away through our fingers.**

This will naturally lead the children to understand, and help them to explain why it is that, all the liquids they see are in bottles, glasses, basins, jugs, or vessels of some sort; and why there must not be the smallest hole or crack in the vessels, or the liquids in them would **ooze out,** *and* **flow away.**

5. *Now empty the water slowly from the saucer into the basin, and let the children observe and tell what takes place.*

When the saucer is tilted, the water in it **cannot stand in a heap.** It falls over the edge, and **flows in a stream** into the basin.

We say the **water pours out.** We can pour liquids from one vessel into another, **because they flow.**

III. Liquids flow Down

Pour some water very slowly from one vessel into another.

Which way does the water flow? It flows **downwards.**

Let us see if we can make it flow upwards this time.

Place a slate on the table, pour a little water on it, and tilt one end, calling upon the children to notice which way the water flows now. **It flows down.**

Tilt the other end.

It is the same; **the water still flows down. It will not flow up.**

Call attention to the rain. Lead the children to tell that this water falls **from the clouds** *overhead* **downwards**; *it runs off the roofs of our houses* **downwards**; *it flows* **down the pipes, down the gutters, down the drains,—always down, never up.**

All liquids are like water in this—they **flow down; they cannot flow up.**

They flow simply because they are **always trying to get lower and lower down.**

IV. Liquids break up into Drops

1. *Dip a stick into water, and hold it up for the children to see that some of the water is hanging at the end of it.*

Shake the stick, and lead them to describe the shape of the little drop of water that falls from it. It is a **little round ball of water.**

2. *Dip a small brush into the water, and shake it over a greasy slate, or a dusty tray.*

Call upon the children to tell what happens.

The water falls from the brush in **little round drops**, which roll about on the tray.

3. *Now tilt the tray slightly, and let the children observe what becomes of the drops of water on it.*

They roll down the slope of the tray, **running one into another** as they go, and **flow in little streams to the lowest part of it.**

But they are not separate round drops now. They have all joined together again, **to make a little pool** of water at the bottom of the tray.

Show that this can be done quite as easily with either of the other liquids.

All liquids readily **break up into drops**; and **the drops run together,** and unite again when they meet.

V. Liquids have no Shape of their own

1. *Call attention once more to the two saucers standing on the table.*

What is the shape of the saucers? **Round or circular.**

Now watch while I fill one of them very slowly with water. The water spreads out, and little by little fills the whole of the saucer, till the top of it is level with the edge.

What must be the shape of the water in the saucer now? The water is **the same shape as the saucer itself**—it is **round.**

Put some saw-dust into the other saucer, and let the children see that this does not spread out to fill the saucer, as the water did. It stands up in a heap in the middle. The saw-dust does not take the shape of the saucer.

2. *Now pour the water carefully out of the saucer into a variety of vessels, one after the other—a tumbler, a jug, a bottle, and an old meat-tin will serve the purpose—and lead the children to observe that, in each case,* **the water fills up every part of the vessel,** *and therefore* **takes the shape of it.**

Show too that the **water always keeps a level surface.**

We may slant the vessel as we please, but the water itself always stands level. We **cannot make it stand in a heap;** we **cannot make it slant.**

Summary of the Lesson

1. Liquids will not stand in a heap; they flow or spread about, and keep a level surface.

2. Liquids flow down. They flow because they are always trying to reach the lowest level.

3. Liquids break up into drops. The drops run together, and unite again when they meet.

4. Liquids have no shape of their own. They take the shape of the vessel which holds them.

Lesson II

THE GROUND WE WALK ON

Provide the following articles for illustration: a large stone and a lump of clay, some sand, inch cubes of cork, oak, stone, and clay, some powdered chalk and garden mould, a flat piece of wood, a saucer, a large basin, and a jug of water.

I. Introduction

Refer to the lesson on water, and lead the class step by step to tell why they learned to call water a liquid.

(*a*) It flows about. It always flows down, never up.

(*b*) It breaks up into drops. The drops run one into the other again, if they touch.

(*c*) It has no shape of its own, but always takes the shape of the vessel that holds it.

(*d*) It cannot be grasped by the hand. It would run away between the fingers.

(*e*) It cannot stand in a heap, or on the slant, but always keeps a level surface.

II. Solid Things

Call attention to the **clay**, *the* **stone**, *the* **sand**, *and the* **garden mould.** *Elicit that these things are* **dug out of the ground**—*they form part of the ground we walk on.*

1. *Lay the stone and the lump of clay on the table, and point out that these things will stand where they are placed till we remove them.* **They will not flow away as water does.**

2. *Shake the stone and the clay. Notice that we cannot shake drops from these things, as we did from the water in the brush.* **Stone and clay do not break up into drops, when they are shaken.**

3. *Let the children examine the sand now for themselves; and lead them to discover that* **each grain of sand is a little particle of stone.** *A lens would make this very clear to them.* **Under the glass each grain looks like a large, rounded pebble.**

Sprinkle some of the sand into a saucer, and point out that **the little particles do not run together,** *and unite into one piece again, as drops or particles of water would.*

4. *Let the children take the stone and the clay in their hands. They can handle these things, but* **they could not pick up water,** *or any other liquid, in their hands.*

5. *Place the two things, one by one, in a saucer. Show that they* **stand up in a heap** *at the bottom of the saucer.* **They do not spread out, to take the shape of the**

vessel in which they are placed. **They have a shape of their own,** and they keep it.

Pour some water into the bottom of the saucer to make the contrast clear.

Show that **the water itself spreads out** *on all sides, to fill up the whole of the space between the stone and the rim of the saucer.*

Clay and stone are not liquids. We call them **solids.**

Solid Bodies **do not flow; do not break up into drops; have a shape of their own;** and **do not take the shape of any vessel** into which they are put.

Point out that **the ground we walk on is solid.** We could not stand on the water of the pond.

III. Light and Heavy Things

1. *Produce the cubes of cork, oak, stone, and clay, and without saying anything about them, drop them one by one into the water, calling upon the children to watch and observe what happens.*

They see that two of the cubes at once **sink to the bottom** *of the water and remain there, while the others* **rest near the top.**

Push these two down to the bottom of the water with the hand, and show that, immediately they are left to themselves, **they fly up to the surface again.**

They will not stay with the other two at the bottom of the water.

2. Now let us try to find out the reason for this. We will remove all four things from the water, and place them on the table side by side.

Look at them one by one as they stand there. What can you tell me about their shape? They are all **the same shape.**

What about their size? They are all **the same size.**

So far our eyes tell us that all four things are alike. But we know they must be different in some way, because

they act differently. As our eyes will not tell us what we want to know, we must try to find out in some other way.

3. *Bring a child to the front, instruct him to extend his hand at arm's length, and then place the four cubes in his open palm one by one, commencing with the cork.*

While this is being done lead him to discover, **by the sense of feeling alone,** *that there is an important difference between them, which we could not find out by looking at them.* **One feels heavier than the other.**

Let him tell how he learns this. **He feels the weight pressing down upon his hand**; *some of the things press more than others.*

It will be an easy matter for him to pick out the stone and the clay as **the heavy things,** *and the wood and cork as* **the light ones.**

4. *This done, let him put all four cubes back into the water once more.*

Which of them are on the top of the water now? The **wood** and the **cork.**

Are they light or heavy? **Light.**

What has become of the heavy things—stone and clay? They are **at the bottom.**

What do you learn from this? We learn that **heavy things sink in water; light things float on the top.**

IV. Mud and Sand

Fill three tumblers with water, and put some powdered chalk in the first, some fine sand in the second, and some garden mould in the third.

Stir the water for a time, and then call upon the class to observe what happens, when the stirring ceases.

1. As long as the water is moving, the sand, chalk, and mould **float about in it.**

2. The sand is the first to sink to the bottom when the water becomes still. **It is heavier than the chalk and the mould.**

3. The chalk and mould are some time in settling. When they settle at the bottom, the water becomes clear.

We learn from this that some things—like sand, chalk, and earth (mud)—which **sink in still water,** are kept afloat **as long as the water is moving.**

V. Why Things float

Set one of the children to press a broad, flat piece of cork or wood down into a bowl of water with his hand, and tell what he observes.

Elicit step by step that the water seems **to press** *or* **push the wood up,** *as he presses it down. He* **can feel** *the upward pressure.*

As soon as he lets go, **the wood rises to the top** *again.*

Explain that:—

(*a*) **The water is actually pressing upwards.** The upward pressure of the water is greater than the weight of the wood pressing downwards. When the wood is left to itself **the water presses it up,** and makes it float.

(*b*) The water also presses upwards against the stone, clay, and other heavy bodies, but **the downward pressure of their weight is greater than the upward pressure of the water,** and so they sink.

Summary of the Lesson

1. Solid bodies do not flow.
2. They have a shape of their own, and they keep it.
3. Some solids are light; others are heavy.
4. Light things float in water; heavy things sink.
5. Some things float as long as the water is kept moving, but sink to the bottom when the water is still.
6. Things float because the water presses or buoys them up.

Lesson III

THINGS POROUS

Provide the following articles for illustration: a large sponge, a saucer, a jug of water, a large, round pebble, pieces of bread, salt, lump-sugar, pumice-stone, chalk, cane, soft wood, charcoal, and coke; five small flower-pots, some garden-mould, gravel, and sand (coarse and fine), a new brick, a small pair of scales.

I. Meaning of the word Porous

1. *Fill two flower-pots with dry garden-mould and sand respectively, and stand them in a shallow tray of water. Point out that* **the water** *gradually* **begins to disappear** *—that it gets* **lower and lower in the tray.**

At the same time half-fill another pot with moist soft clay, press it well in, and stand it in a similar tray.

After a while let two of the children turn the mould and sand out of the pots, and they will see that both, instead of being dry as they were at first, **are now quite wet.**

While this is going on, half-fill two other flower-pots with some of the same dry mould and sand, and then fill them up with water. The children will of course observe **the water trickle through the hole** *in the bottom of each pot.*

Call upon them to explain.

The water **soaks through the mould and the sand.**

2. Now look at the clay in the other pot. The water does not seem to have got lower in this tray. Let us fill the pot up with water, and see whether it will soak through the clay, as it did through the mould and the sand, and trickle through the hole in the bottom.

Hold the pot up before the class, and show that **none of the water soaks through the clay.**

We are going to try to find out what this means.

3. *Place a large, dry sponge in a saucer of water, so that all may see, and then call upon one of the children to come out and take away the sponge. This done, turn the saucer up, and show that there is* **no water at all in it now.**

What has become of the water? It is **in the sponge.**

See, I will squeeze it all out into the saucer again.

Let us try the same with this smooth, round stone.

Does the water leave the saucer and go into the stone, as it went into the sponge? No.

4. Now look at the sponge and the stone, and tell me what difference you can see in the two things.

There are **little holes all over the sponge,** but there are **no holes in the stone.**

Yes, and the holes are not only on the outside of the sponge, but **all through it.**

Cut a piece of it away and show the holes in it.

It is **full of holes.** These little holes are called **pores,** and because the sponge is full of holes, we say that it is **porous. Porous means full of holes.**

The sponge is able **to suck up the water, because it is porous,** and the water **fills up the little holes in it.** The stone cannot do this, because **it is not porous.**

5. Here is a piece of bread. If I stand it in a saucer with only a little water in the bottom, I shall soon find the bread **wet all through.** It will act just as the sponge did.

Look at the bread, and you will see that **it is porous, like the sponge.**

You can see the holes in it.

Show the pores in pieces of pumice-stone, cane, soft wood, coke, charcoal, or any other substance ready to hand. **These are all porous things.** They would all **suck up water into their pores.**

6. *Take a common brick now (a new one if possible); weigh it, and place it in water. Notice that the water*

gradually **gets lower and lower** *in the vessel. After a short time take out the brick and weigh it again. It* **weighs heavier** *than it did at first.*

Elicit that this is because of the water it holds. **The brick is porous.** The water has soaked into its pores.

7. Now tell me why the water soaks through the mould and the sand in those flower-pots?

The **sand** and **mould** must be **porous** too.

Show and explain that there are **spaces between the grains of sand,** *and between the little particles of soil.* **These spaces are the pores.**

Cut off a piece of the clay now, and show that the particles of this substance are very close. **Clay is not porous.** Water cannot soak through it.

8. *Refer now to the* **slate roofs** *of houses.*

We do not want the rain to soak through into our houses. So we cover them with slate roofs. What kind of substance then must slate be?

It must be like clay—**not porous,** so that **water cannot soak through it.**

Tell that slate (like stone, clay, and chalk) is dug out of the earth: it forms part of the earth itself.

II. The Pores are not always to be seen

1. Here are two lumps of chalk. I am going to weigh them in these scales. I put one into each scale-pan. See, they are **exactly the same weight**; the scales are level.

Now I drop one of them into this basin of water, and leave it there for a minute or so.

That will do. I will now take it out, and put it in the scale again.

What happens? The scale goes down.

What does that show? It shows that **the chalk** which has been taken out of the water **is heavier** than the piece in the other scale. It is heavier than it was before it was put into the water.

What makes it heavier? **It has sucked up some of the water** out of the basin. It is **the water** in the chalk that **makes it heavier** than it was.

Think of the sponge and the bread once more. They sucked up water. Why? **Because they are porous.**

Then what kind of substance would you expect the chalk to be? A **porous substance.**

2. Take the dry piece of chalk in your hand, and see if you can find any pores in it, such as we saw in the sponge.

You cannot find any; but I will show you that there are pores in the chalk, **although you cannot see them.**

Place the dry piece of chalk on a plate containing a little coloured water, and hold it before the class so that they may see the coloured liquid rising through the white substance.

The pores in the chalk are **so small that we cannot see them,** but we know now that they are there, because we **see the water rising in them** from the plate.

Chalk, then, is a porous body.

3. *The same experiment may now be shown with a piece of lump-sugar or a piece of salt.*

We cannot see the pores in the sugar or the salt, but we find that if we lay these things on a wet surface, **the lump becomes wet through** in a short time; and if we use coloured water, we can actually see the water gradually rise, as we did in the chalk.

III. Absorbents

1. Porous bodies, we have seen, have the power of **sucking up water** through their pores.

Now I want you to remember a long word, which you can use instead of saying that these things **suck up water.**

The word is **absorb.** It means the same thing. All

porous bodies **absorb,** *i.e.* **suck up** water through their pores; and because they do this we call them **absorbents.**

Call attention to some common substances, which are very useful to us, only because they are porous *and* absorbent, e.g. **blotting-paper,** *because it* **sucks up** *or* **absorbs** *ink;* **sponge,** *because it* **sucks up** *water or other liquids, and can hold them in its pores;* **towels** *and* **house-flannels** *for washing up, and so on.*

2. *Next show that some are equally useful to us* **because they are not porous** *and* **not absorbent.**

What would be the use of a porous vessel for holding liquids? None; the liquids would all trickle through the pores of such a vessel and be lost. We therefore use glass, horn, silver, earthenware or china vessels, for this purpose, **because they are not porous.**

Why do we wear leather boots? Because **leather is not porous,**[1] and **does not absorb water.** The leather therefore keeps our feet dry in wet weather.

Summary of the Lesson

1. Porous things are full of holes.
2. We cannot see the pores in some porous things.
3. Porous things absorb or suck up liquids.
4. Vessels for holding liquids must not be made of porous substances.
5. Porous material would not do for our boots and shoes.
6. Sand, gravel, chalk, and soil, are all porous.
7. Clay and slate are not porous.

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[1] This, although not strictly true, is quite sufficient for our present purpose. It would apply, of course, with more truth to india-rubber galoches—india-rubber being absolutely non-porous.

Lesson IV

A PIECE OF CLAY

Articles required for illustration: a lump of newly-dug common clay, and pieces of stone, sand, gravel, and chalk, specimens of Kaolin and other clays, a basin of water, a knife, a hammer, the clay balls, cubes, and bricks made during some former lesson, a piece of dough, a flower-pot, a lump of sun-dried clay.

I. Introduction

Produce one of the lumps of newly-dug clay, and proceed to elicit from the class all they can tell about it.

Look at this piece of clay, and tell me something you learned about it in our last lesson.

It is **not porous.**

Ah! what does that mean?

Porous means **full of holes,** or **pores,** like a sponge; but there are **no pores in clay.**

How could you prove this?

If we put water on clay, it will not soak through; but **water always soaks through porous things.**

In illustration of this press a hollow in the lump of clay, as it stands on the table, and fill it with water. The water remains in the hollow: **it will not soak through the clay.**

We are now going to see what else we can find out about clay.

II. Moist Clay

1. Brown Colour.—Look at the clay as it lies on the table. Your eyes will tell you something as to its colour. It is of a **greyish-brown colour.**

If possible have specimens of other clay at hand, and show that all clay is not this colour—some kinds are **blue-black** *or* **slate colour,** *some* **yellow,** *some* **reddish-brown,** *and so on.*

Show the specimen of **Cornish clay** (*Kaolin*). *Tell that this is the* **purest form of clay,** *and it is* **white.**

Explain that the rougher kinds of clay, such as those on the table, get their colours from other things which lie near them in the ground.

2. HEAVY.—*Let one of the children now take the piece of clay in his hand.*

What is the first thing you find out by handling it? The clay is **heavy.**

How could you prove that it is heavy? By putting it into the water.

Let him do so, and point out that the clay sinks to the bottom of the water.

What does this tell us? It tells us that the clay is heavy; **it sinks because it is heavy.**

3. FEELS SMOOTH.—*Set him next to take the clay out of the water, and rub his hand over it.*

What do you notice about the clay now? It **feels smooth and moist.**

4. SOFT.—*Instruct him to take the clay in both hands and squeeze it; and then let him do the same with the stone. Elicit as before.*

Clay is soft. We can squeeze clay in our hands; **we cannot squeeze the hard stone.**

Do you remember any other way of finding out whether a thing is soft or hard? We can find out **by cutting it.**

Give him a knife and ask him to try to cut off a piece of the clay.

Clay is soft. It can be **easily cut** with a knife.

5. TOUGH.—*Illustrate further the softness of the clay by kneading, rolling, folding, and twisting the lump on the tray.*

Drop it on the floor, and beat it with a hammer, and point out that the clay changes its shape, but **does not break.** *Treat a piece of chalk in the same way.*

Clay is tough as well as soft; it **does not easily break.** Chalk is brittle; it breaks easily.

6. Plastic.—*Hand some pieces of the clay round the class now, and instruct the children to knead them up on their slates, as the teacher has already done.*

Let one of them work his piece up into a **ball**; *let another make a* **cube** *of his piece; set a third to make his piece into the form of a* **brick,** *and so on.*

Produce the similarly-shaped, dried pieces, made at some former lesson, and tell that these were shaped when they were soft, like those now in the hands of the children.

They have **kept the shape that was then given them**; those which have just been made would do the same, if we left them to get dry and hard. The **moist, soft clay** is said to be **plastic,** because we can **mould it into any shape** we please.

Show a piece of dough, or make some with a little flour and water, and repeat the experiments with that. Work it up into the shape of a biscuit, and compare it with an actual biscuit.

Dough, like clay, is plastic. Why?

The experiments may be further repeated with a piece of **soft wax** *or some* **putty.**

These things are plastic. Why?

III. Dry Clay

1. *Produce the lump of dry clay now. Let the children take it in their hands and examine it. They will find that—*

(*a*) *They cannot squeeze it in their hands, as they did the moist clay.* **Dry clay is hard.**

(*b*) *It does not feel smooth to the touch.* **Dry clay is rough and cracked on the outside.**

Elicit from this that it is the water in the moist clay that makes it soft and smooth to the touch. **The dry clay has no water left in it.**

2. *Scrape the dry clay with a knife, and show that* it

crumbles to pieces *readily. Drop a piece of it, or strike it with a hammer.* **It breaks easily.**

Treat the moist clay in the same way.

Does the moist clay break? No.

Why not? Because moist clay is tough and plastic.

Then what shall we say about the dry clay? **Dry clay is brittle.**

3. *Now place the dry clay on a slate, and let water trickle on it slowly, a few drops at a time, calling upon the children to observe what happens.*

Where is the water? It has disappeared. It is not on the slate, for the slate is dry. **The dry clay has sucked it up.**

Let fall some more drops, and show that the same thing happens again.

The water is in the clay. **The clay has sucked it up.**

How can we say this in another way? We can say that **dry clay absorbs water.**

Then what else can you tell me about this dry clay? **Dry clay** must be **porous.**

Look at this piece of dry clay, and tell me whether you can see the pores or holes in it. No.

Is it porous then? Yes, it must be porous **because it sucks up water.**

4. *Illustrate its greediness for water by letting one of the children put the piece of dry clay to his tongue, and explain what happens.*

The clay sticks to the tongue: it robs the tongue of all the moisture it can get, and is greedily sucking to get more.

Our piece of dry clay on the table will absorb a large quantity of water. It will suck up water till all its pores are quite full; **but after that it will not take another drop.**

Put a piece of the dry clay in water, and after leaving it there for a few minutes take it out, and show that it is no longer hard and brittle; it can now be kneaded up.

It has sucked up water: **the water has made it soft, tough, and plastic once more.**

Summary of the Lesson

1. Clay is dug out of the earth.
2. Clay is heavy, soft, tough, plastic, and not porous.
3. When clay is dry it becomes hard, brittle, porous.
4. Dry clay will absorb water till its pores are full, but after that it will not take in any more.

Lesson V

CLAY—ITS USES

The teacher will require: a lump of moist clay, a small pair of hand-tongs, a can of water, one or two tumblers, a hammer, specimens of red ballast, two new bricks (one of which should be put into water at the commencement of the lesson), a pair of scales, some sifted ashes from the fire-grate, the sun-dried brick that was moulded in class on some previous occasion, specimens of Kaolin, a piece of common drain-pipe, a flower pot, and a few earthenware and china articles.

A pencil box, from which the lid and bottom have been removed, could be extemporised to serve the purpose of a mould **for making a brick.**

I. Introduction

1. *Roll a piece of clay into a ball soon after the commencement of school, and put it into the middle of a bright red fire. Call the attention of the children to what is being done, and tell them that during the morning we are going to have another lesson about clay. We want to find out first of all what will happen to the clay in the fire. We will leave it where it is till we want it.*

2. *When the time for the lesson comes round, take the clay out of the fire with the tongs, place it on a slate in front of the*

class, and let the children examine it. As far as their eyes can tell them, they will notice that the fire seems to have had no effect on it. It is **not altered in shape or size.**

Elicit that **some things would have burnt away** *in the fire; but the clay has not burnt away—it is all there just as when we put it in.*

3. *Show a similar piece that has been kept in the fire for a long time, and left to cool. Explain what has been done to it, and tell that, as the one we have just taken out of the fire is too hot to handle, we will examine this instead.*

Hand it round the class, and the children will see at once that it is now **as hard as a stone.**

The clay has been **baked** in the fire. The fire has made it hard like this.

II. Properties of Baked Clay

1. *Put a piece of baked clay into a tumbler, fill it up to the brim with water, and then call upon the children to observe what takes place. They will see the water gradually sink in the glass.*

The water has not flowed over the top of the glass. What has become of it?

Lead the children to find out for themselves that it must have **soaked into the clay.**

Would water soak into this piece of moist clay? No; **moist clay is not porous.**

Then what shall we say about this baked clay? It must be **porous. It absorbs,** or **sucks up the water into its pores.**

2. Here is a piece of dry clay. What would happen to it if I put it into the water? It would become **soft and plastic** again.

Then let us take the ball of baked clay out of the water, and see whether that is plastic too.

Let the children handle it, and try to squeeze and press it

into a different shape. They find that **the baked clay is too hard** *for them to squeeze;* **it is not plastic.** *Explain that* **it can never be made plastic again.**

3. *Strike it a smart blow with a hammer, and show that it is* **brittle; it breaks into pieces with the blow.**

Baked clay, like dry clay, is **porous**—it absorbs water. But the water **cannot make it plastic again—it is a hard, brittle substance.**

III. Uses of Baked Clay

Red Ballast.—

Show the specimen, and tell what it is called.

Put a piece of it in water, and strike it with the hammer, as we did the clay, to prove that it is **a hard, brittle,** *and* **porous substance.**

Tell that this is nothing but clay, **which has been burned or baked** *in great heaps in the open air.*

The **baking has changed the moist clay** into this hard, brittle, porous substance.

It is very useful for making hard dry roads. Why?

Bricks.—

1. *Take the brick out of the water now. Place it in one of the scale-pans of a pair of scales, and a dry new brick in the other. In the absence of scales let one of the children balance the bricks in his hands.*

Why should this one be so much heavier than that? **It has sucked up water.** It is the water that makes it weigh heavier.

What can you tell me about the brick then? It is **porous.**

2. How does the bricklayer make his bricks fit in when he is building? He breaks off pieces of them with his trowel.

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What do we learn from that? We learn that **bricks are brittle**, or they would not break.

Show in this way that bricks are the same kind of **hard, brittle, porous things,** *as the* **red ballast** *we have just examined.* **Bricks too are made of clay.**

3. *Mix some clay and ashes together into a stiff paste with water, and when it is as soft and smooth as putty, press it into the mould, which should be stood on a small drawing-board, and wetted inside to prevent the clay from sticking to it. The top may be smoothed off with an old knife or a ruler, and when the mould is lifted, the brick itself will be left on the board.*

Tell that in the brick-fields, where tons of the material are prepared at a time, the mixing is all done in a mill.

4. *Show a brick which was made at some previous lesson, and has since been dried in the sun. Tell all about it, and proceed:—*

This brick, which we made in the class a long while ago, is now dry and hard. Would bricks of this sort do for building?

The children will have no difficulty in telling that **this brick is nothing but dry clay;** *that as* **dry clay is porous** *it would* **suck up the rain;** *and that the water would make the clay* **soft and plastic** *again.* **A house built with such bricks would fall to pieces.**

5. *This will lead to a brief description of the* **brick-kiln.**

The bricks after being well dried in the sun are **piled up in great stacks,** and **burned or baked** for a week and sometimes a fortnight.

It is the baking that **changes the nature of the material,** and makes the bricks suitable for building purposes.

EARTHENWARE.—

Tell that **tiles, chimney-pots, drain-pipes,** *and*

flower-pots *are also made of common clay; and that our* **plates** *and* **dishes, basins** *and* **jugs,** *and the* **china cups** *and* **saucers** *and* **ornaments** *are made of clay too, but of a purer, whiter kind.*

China, or porcelain as it is called, is made of the **purest** and **whitest clay** that is to be found.

Show the specimen of **Kaolin** *or* **China clay.**

As clay of all sorts is a kind of earth, we give the one common name **earthenware** to all things made from it.

Summary of the Lesson

1. Clay does not burn away in the fire. It bakes hard like stone.

2. Moist clay is soft, tough, and plastic. It is not porous; it will not absorb water.

3. Dry clay is hard, brittle, and not plastic. It absorbs water because it is porous. The water would make it plastic again.

4. Baked clay is hard, brittle, and porous. It will absorb water, but it can never be made plastic again.

5. Ballast, bricks, tiles, flower-pots, drain-pipes, and all kinds of earthenware are made of baked clay.

Lesson VI

A PIECE OF CHALK

The teacher will require two lumps of rough chalk. One of these should be weighed, and then placed in the middle of a bright, red fire as early as possible in the morning. If it is taken out just before the commencement of the lesson, it will be cool enough to handle when it is wanted. This of course must be done in the presence of the class. Set it aside out of sight for the present.

I. Introduction

Show the piece of rough, unburnt chalk, and proceed at once to

elicit from the children that this is another of the substances that are **dug out of the ground.**

If there are any "Downs" in the neighbourhood of the school, the children will be familiar enough with chalk. Explain that those great hills, hundreds of feet high, are all chalk. In other districts it must suffice to mention that such hills are to be found in many parts of the country.

We are now going to see what we can learn about this substance—chalk.

II. Properties

1. *The children will find no difficulty of course as regards its colour. Their eyes will tell them that it is* **white.** *We use the* **white chalk** *for writing on the* **blackboard.**

Compare it with a piece of newly-dug clay. Elicit that it is **harder than clay;** *that it is not moist like the clay, but* **dry;** *and that it is* **brittle** *and* **breaks easily,** *while clay is tough.*

2. *Drop the two things on the floor, or strike them with a hammer, and show that it is so.*

Rub the chalk on the blackboard. It makes a mark **because some little pieces break off** *as we rub it. Try the same thing with a piece of stone.*

3. *Put a piece of the chalk in a tumbler of water, and stir it up.*

The chalk, you see, breaks up in the water, and **turns the water white like milk.** We will now stand the tumbler aside for the present. We shall want to look at it by and by.

III. Chalk and Lime

1. *Turn now to the other piece which has been in the fire. It is cool enough to handle by this time. Lead the children in the first place to tell that the chalk, like clay,* **does not burn away** *in the fire. It looks to be exactly the same in shape and size, as when we put it into the fire.*

Look at it again, side by side with the other piece of chalk on the table. Do you notice any difference in its colour? It is **not white now,** like the other chalk. It has turned **a dirty yellowish white.**

2. *Let the children take it in their hands, and try to break it.*

It breaks much more easily than chalk, and it gives a **crackling sound** as it breaks. It crumbles up easily in the fingers; and yet it is not so soft as the chalk, for **it will not make a mark on the black-board.**

3. *Place it in the scales now and weigh it.*

It weighs less than it did when it was put into the fire. It has lost something in the fire.

The heat of the fire has made all these changes. It is no longer chalk. We call it **lime.**

4. *Put a small piece of the lime into a tumbler of water, and observe that* **it makes a hissing sound,** *as soon as it touches the water. Stir the water and stand it aside. In a very short time* **the whole of the lime will disappear,** *leaving the water itself quite clear.*

Produce the other tumbler now in which we put the chalk.

When we stood this aside, the chalk had made the water white like milk. It is no longer white; **it is quite clear now.**

What has become of the chalk?

Call attention to the chalk lying in a wet layer at the bottom of the glass.

We can pour off this water, and leave all the chalk behind. But we could not do this with the other tumbler. **The lime has disappeared in the water.** It is all there although we cannot see it. We could not pour away this water **without pouring away the lime with it.**

We say the **lime dissolves in the water;** and we call this water **lime-water.**

We also say that the lime is **soluble**; **but chalk is not soluble.** It does not dissolve in water.

5. *Break off another piece of the lime, put it in a saucer, and let some water trickle on it slowly, calling upon the children to observe what happens.*

(*a*) The water disappears the moment it falls. **The lime seems to suck it up.**

(*b*) Presently a **cloud of steam** begins to pour out from the lime, and **the lump begins to crack.**

(*c*) If we put our hand on the saucer, **we find it has become very hot.**

(*d*) The lime at last falls away into **a dry powder.** The lump has broken up; and **there is no water to be seen.** It has all disappeared.

6. *Tell that this lime, which is thirsty for water, and sucks it up so quickly, is called* **quick-lime.** When chalk is heated in the fire, **it changes to quick-lime.**

Call attention now to the white dry powder in the saucer. Pour some more water on this, and observe that there is no longer any hissing sound, no longer any cloud of steam rising from it.

The lime is not thirsty for water now; it has had enough; **its thirst is slaked.** We now call it **slaked lime.**

Notice that it lies in the saucer, a wet, sticky, muddy substance.

7. *Tell (and let the children see for themselves later on) that if it is left for a while, it will* **set hard like stone.**

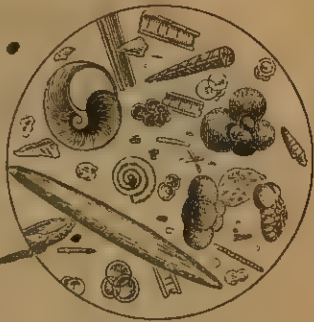
Lead the children to tell from this that the bricklayer makes his **mortar** *with lime. It sticks fast to the bricks, and when it sets hard,* **it holds the bricks together.** *He uses quick-lime for this purpose.*

Mix the rest of the quick-lime with some sand, and pour water on the mixture. This is the way he makes his mortar.

IV. What Chalk is

Turn once more to the tumbler, with the wet layer of chalk lying at the bottom.

Tell that if a tiny piece of this wet chalk mud, no bigger than a pin's head, were pressed out flat and then dried, it would form a white powder; that if a little of this powder were then put under a strong glass, to make it look larger, we should be able to see that it is made up of **immense numbers of shells.**



Long long ago each of these was **the shell of a little living creature.** The tiny animals themselves died, but their shells were left behind. These tiny shells, which we cannot see except with a very strong glass, have made chalk.

Show a picture of the magnified shells. Each one was once the home of a little creature.

Immense numbers of them could stand on a sixpence. Think that all those great hills of chalk are made of nothing but these shells.

Promise the children that some day they shall hear more of this.

Summary of the Lesson

1. Chalk is a white, soft, brittle substance.

2. It does not burn away in the fire. It changes into lime.

3. This lime sucks up water very quickly. It is called quick-lime.

4. Water changes quick-lime into slaked lime.

5. Lime dissolves in water; chalk does not dissolve.

6. Chalk is made up of immense numbers of tiny shells, in which little animals once lived.

Lesson VII

THE AIR AROUND US

Provide the teacher with: a large basin, a can of water, a flask, some small stones, a piece of glass-tubing, one or two large sponges, a large, well-corked flask fitted with an air-tight glass-and-india-rubber tube, with a spring clip for closing it at will, a good pair of balance, the spirit-lamp, a sand bath, a fan, a pair of bellows, a few feathers, little pieces of paper and other light things to lay on the table, and a toy boat.

I. Air takes up Room

1. *Fill a glass flask up to the brim with water; and then call upon the children to notice what happens, if we try to pour more water into it.*

Drop a few stones into the flask, and point out that the same thing happens. **The water overflows in each case.**

Why is this? The water takes up all the room inside the flask. There is no room for anything else, because the flask is full of water. **Some of it must flow out to make room for the stones.**

2. Now I will pour all the water and the stones out again, and you will perhaps tell me that the flask is empty, for we cannot see anything in it. Let us find out whether it is really empty.

[illegible] the flask, mouth downwards, in a vessel of water, and then call attention to the water inside the neck of the flask. **It is not on a level with that all round it.**

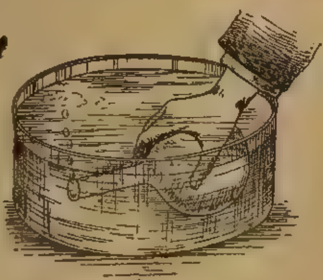
It rises only a little way up the neck. **We cannot force the water up into the flask itself.**

Why can't we make the water go up into the flask? I will show you.

3. *Slant the flask on one side, and call attention to the* **sudden gurgling sound** *that follows. Notice too* **the bubbles** *that rise up through the water.*

Something is passing out of the flask, and **as this something passes out**, the water rushes in. The flask is now full of water.

What is this something that came bubbling up out of the flask? It is **air.**



We cannot see the air, but the flask, which you said was empty, **was really full of air** — so full that **there was no room for the water to get in.** It was the air from the flask that **made those bubbles,** when we slanted it.

4. Repeat the experiment with a piece of glass tube, closing one end with the finger or thumb, and plunging the open end into the water. Show that the same thing happens again. The water will not rise in the tube, **because the tube is full of air.** *Slant it to* **let the air-bubbles escape** *as before, and then show that the water at once rises in the tube.*

Now plunge the tube in again without closing the top. This time the water inside the tube stands at the same level as that all round it.

Why? Because, as the water enters the tube below, **it drives the air out at the top** to make room for it.

5. Show the sponge. Lead the children to notice that it is "full of holes." Elicit that these **holes in the sponge** *are called* **"pores,"** *and that the sponge is said to be* **porous,** *because it is* **full of pores, or holes.**

Place the sponge now in a saucer of water, and let the children observe that it sucks up all the water into its pores.

Squeeze it, and show how the water is forced out again.

Now take a dry sponge, and force it down below the surface of the water in the basin, calling upon the children to observe carefully what takes place.

6. *They see* **bubbles rising up through the water.** *Elicit from what they have already learned that—*

(*a*) **These bubbles are caused by air.**

(*b*) **This air must have come out of the sponge.**

(*c*) **The water forced the air out** *of the pores of the sponge* **to make room for itself.**

Sum up what has been done by impressing upon the children that—

(*a*) *Not only is there air in the pores of the dry sponge and in the "empty" flask, but that* **there is air everywhere.**

(*b*) **This air,** *although we cannot see it,* **is as much a real thing** *as water, stones, and other things we see around us.*

(*c*) **Air,** *like all other things,* **takes up room.**

II. Air has Weight

1. *Let one of the children hold a basin in his hand, while it is filled with water, and call upon him to tell what he observes.*

The basin **feels heavier** than it did, before the water was poured into it.

What do we learn from that? We learn that **the water weighs something.**

Show that it would be the same, if we filled the basin with stones, sand, or anything else, for **all these things weigh something.**

2. *Now produce the air-tight flask. Remind the children that, although the flask looks empty, it is not really empty*—**it is full of air.** *All the room inside the flask is filled with air.*

Weigh the flask, and carefully note down its weight on the blackboard.

Then proceed to remove some of the air, either by sucking it through the tube, or by heating the flask over the spirit-lamp.

N.B.—*The flask should be stood in a sand bath over the flame, to save it from flying.*

This done, close the tube by means of the spring clip, and

when the flask is full weigh it again. **It weighs less now.**[1]

Why is this? Because **some of the air has been taken out.**

What does that tell us? It tells us that **air,** like water and other things, **weighs something.**

III. Air can be felt

1. *Set one of the children to move his hand about in the water. He can feel the water as well as see it.*

Now let them all wave their hands to and fro in front of them, and lead them to tell that they **can now feel something,** *which they could not feel while they sat still.*

Explain that this **something which they can feel is air;** *that there is air all round us, although* **we do not feel it till we make it move.**

2. *Give one of the children a fan, and let him wave it to and fro in front of the rest. All will feel the air plainly enough now.*

[1] *N.B.*—A cubic foot of air weighs about one ounce.

Blow the bellows against their hands.

Air then like water is something **which can be felt**; but we do not feel it till we set it moving, as we did with the **fan**, the **bellows**, and **our hands.**

3. How do we know that the air really moves?

Wave the fan to and fro near the table, so as to make the feathers, pieces of paper, and other light things that are lying on it, fly about.

The fan moves the air; the air moves the pieces of paper and other things.

Put the toy boat into the water, and send it along by blowing with the bellows against its sail.

The **bellows moves the air**; it is **the moving air** that **moves the boat along.**

IV. We breathe Air

1. *Instruct each of the children to place one hand on his chest, and take a long, deep breath, following the example of the teacher.*

Repeat the process two or three times, so that all may note carefully what happens, and then call upon them to explain—

What are we doing now? We are **taking in air.**

Where does the air come from? It is **all round us** everywhere.

How do we know we are taking it in? **We can feel it** rush in at our mouth and nostrils. We can feel our chest heave **as it gets full of air.**

What are we doing now? We are **sending the air out again.**

2. *Explain that this is what we call* **breathing.** *We could not live many minutes without breathing. We must be* **constantly taking in fresh air,** *and giving it out again after we have used it. We breathe in this way* **even when we are asleep.** *If we could not get air to breathe,* **we should choke or suffocate.**

Explain that the air, which we take in at our mouth and nostrils, **passes down into the lungs.** *Show the position of the lungs, and tell that* **cows, pigs, horses,** *and* **birds have lungs like ours,** *and breathe air just as we do.*

Summary of the Lesson

1. There is air everywhere although we cannot see it.
2. Air is a real thing and takes up room.
3. Air, like every other thing, has weight.
4. Air can be felt when it is moving about.
5. When it moves, it makes other things move.
6. We breathe air.

LESSONS ON SIMPLE NATURAL PHENOMENA

Lesson VIII

THE SKY

The teacher should be provided with a round glass bowl.

I. Introduction

1. *To render this lesson effective, the teacher would do well to select a bright, clear day for it, so that the children may be able to approach it, with their minds fresh from what they have seen. Commence by leading them to talk about their run to school. How bright and cheerful everything looked. When they raised their eyes above them, they saw everywhere the clear blue sky.*

To-day we are going to see what we can learn about this beautiful sky.

You saw the sky above you on your way to school; you can see it now through the window. But can other boys and girls, in other places, see the sky too? Can people a long way off see it? Yes; wherever we go, **we always have the sky over our heads.**

2. In our last lesson we spoke of something, which is all round us wherever we go. What is that? Air.

This room is full of air; but when I look across it, I can see things on the other side. I can see through the air, but I cannot see through this slate.

We say **the air is transparent,** because we can see through it. This slate, and all other things, which we cannot see through, are said to be **opaque.**

Tell that **this transparent air** *is not only* **all round us** *wherever we go, but stretches high above our heads, and really* **forms the sky.**

We look up through the air around us, and see the blue sky overhead, but **this sky is only the air** itself, which spreads out and stretches upwards to a very great **height.**

II. Shape of the Sky

1. When you look up at the sky, what shape does it seem to be everywhere? **Curve-shape.**

Which part of the curve seems to be the highest? **The part over our heads.**

Where does the curve seem to end? It **seems to bend down** till it touches the earth on all sides.

Show a large bowl (a glass one for preference). Stand it upside down on the table, and lead the children to compare the shape of the sky to the shape of the bowl.

It looks like a very, very large bowl, placed upside down on the earth, just as this one is placed on the table. **It covers the earth** all over **like a great round roof.**

2. *Call attention to the rim of the bowl which touches the table all round.*

Lead the children to tell that, when we get away from the houses, and can see a long way off, **the sky seems to touch the earth,** *just as the rim of this bowl touches the table.*

Tell that this line, **where the sky seems to meet and touch the earth** *all round, is called* **the horizon.**

III. Clouds in the Sky

1. What colour do you say the sky is to-day? Blue. Is it blue all over? I think I can see some parts of it, here and there, that are not blue. Look through the window, Harry, and tell me whether you can see any parts of the sky that are not blue.

Let the child describe to the rest of the class the **small white patches** *dotted over the sky here and there. They look like little heaps of* **loose white wool** *or* **feathers.** *Elicit that these are called* **clouds.** *Point out that sometimes, although not often, there is not one of these little white clouds to be seen; the sky is blue all over. We then call it a* **cloudless sky.**

2. *Lead the children to tell, on the other hand, that they sometimes see no blue sky at all. It is of a* **dull grey colour** *all over.*

Explain that this is because the sky is covered with thick clouds. We then call it a **cloudy sky.**

These thick clouds **hide the blue sky** from us, because they are **opaque**; we cannot see through them. As soon as the clouds roll away, we see the blue sky behind them.

3. *Point out that, although the clouds sometimes shut out the sun, moon, and stars, they are very good to us. They send us* **the beautiful rain** *to make the things grow.*

Trees, grass, and flowers want rain as well as sun to make them grow. In the cold weather the clouds send us **snow and hail** instead of rain.

IV. What we see in the Sky

1. *Call upon the class now to say what else they have seen in the sky besides clouds, and proceed to elicit all they have to tell about the* **sun, moon,** *and* **stars,** *assisting of course where they fail.*

The Sun.—It shines in the daytime only. It looks **like a great round lamp** in the sky. When it is shining **everything looks bright** and cheerful, but at night, when it is not shining, **all is darkness.**

What then does the sun do for us? It gives us **light.** *Tell that it is the light of the sun shining down upon us that gives the sky its beautiful blue colour. How dark and cheerless everything would be without the sun.*

2. How do we feel when the sun shines upon us? We feel **warm.**

The sun then **gives us warmth as well as light.** It is **like a great round ball of fire** in the sky. Without the sun's warmth we ourselves, and all animals, would die. There would be no trees, or grass, or flowers; for these things could not grow without the sun.

Sometimes the thick clouds shut out the sun, so that we cannot see it, or feel its warmth. The sky is then dull and cheerless; there is **no brightness or warmth** anywhere.

The Moon.—At night, when the sun is no longer shining, the moon comes out in the sky.

1. *Lead the children to tell that it does not look like the sun—a great ball of fire. It is* **white and silvery.** *We can*

look at the moon without blinking, but we **cannot look at the bright sun.**

2. *Endeavour to make them talk of the changing shape of the moon, and explain and illustrate on the black-board,* **new moon, half-moon,** *and* **full moon.**

The Stars.—*Let them next talk of the stars, and when they are to be seen.*

1. How many stars are there? There are so many that **we could not count them.** They help the moon to give us light at night, when the sun is not shining on us. They are dotted **like tiny lamps** all over the sky. They shine and twinkle all night long. Sometimes **the clouds shut out the moon and stars,** and the night is then very dark.

2. *Compare the light of the stars with the brilliant light of the sun, and point out that* **all day long** *they are shining up there, just as we see them shine at night. We do not see them in the daytime,* **because their weak, pale light cannot shine through the bright light of the sun.** *But we know they are there in the daytime as well as in the night, because if we go down into a very deep, dark pit, and look up at the sky in broad daylight, we can see them there.*

Summary of the Lesson

1. The transparent air all round us reaches high above our heads and forms the sky.

2. The line where the sky seems to touch the earth is called the horizon.

3. Clouds float about in the sky. They send the rain.

4. The sun warms us and gives us light in the daytime.

5. The moon and stars give us light at night.

Lesson IX

THE SUN

Provide for illustration: a large wire ring and movable ball, and a couple of spring clips to fasten the ring to the edge of the table, Brown's Picture of Sunrise.

I. Introduction

1. *Refer the children to their last lesson, and lead them to tell*

all they can of the sun, as regards its appearance in the sky, and what it does for us. It is like **a great round ball of fire** *in the sky; it gives us* **light** *and* **warmth.** *We feel the warmth of the sun when it shines on us.*

How long does the sun shine on us? It shines on us all day. **It begins to shine** in the morning, and **it goes away** in the evening.

How do you know it is the sun that gives us light? Because in the evening, when the sun is not shining, **it grows dark,** and the next morning **it gets light again,** as soon as the sun begins to shine.

2. Can we see the sun in the sky every day, and all day long? No; we sometimes cannot see the sun at all.

Why is that? Because sometimes there are thick clouds in the sky, and **they hide the sun from us.**

But are you sure the sun is always in the sky in the daytime—say, on a very cloudy day? Yes; because if the sun was not shining, **it would be as dark as it is in the night.**

Quite right. The sun is shining in the sky **if the day is ever so cloudy.** The thick clouds hide the sun from us; but **they cannot shut out all its light.** Some of the sun's light passes through the clouds, just as it would **through our window-blinds,** if we pulled them down.

II. What the Sun is Like

1. The sun, you say, is like **a great round ball of fire.** On a bright day we cannot look at the sun. It hurts our eyes, so that we cannot see well afterwards. We say that things **dazzle our eyes,** when they are so bright that we cannot look at them without making our eyes ache.

Can you tell me whether the sun is always the same colour? It is not always the same colour. All day long, if the sky is clear, **the sun is bright yellow,** like gold. In the evening, just before it leaves us, **it is often red, like fire.**

2. *Remind the children of the beautiful red clouds, which are often seen in the sky in the evening. The clouds are sometimes so red, that they* **almost look as if they were on fire.**

What is it that makes the clouds look red at such times? It is **the sun shining through the clouds.**

Why is it that we sometimes do not see the sun in the daytime? The thick clouds hide it from us.

Then which must be nearer to us, the clouds or the sun? **The clouds are nearer than the sun.**

III. Sunrise, Noon, Sunset

1. We spoke about the window-blinds just now. When are we glad to pull them down? When the sun shines through the window into our eyes.

Do we pull them all down at the same time? No; sometimes one of the blinds is pulled down, sometimes another.

What do you learn from that? We learn that the sun **does not always shine through the same window.**

Ask the children to observe for themselves from day to day that in bright, sunny weather the same blind is always pulled down at the same time in the day.

The sun always shines through the same window at the same time every day, when it is not hidden by the clouds.

2. *If a suitable time were chosen for the lesson, the teacher might so arrange the class as to make it necessary to move some of the children from one side to the other, as the sun began to shine into their faces. This, of course, would naturally lead to the same deduction that* **the sun is not always in the same part of the sky.**

Lead the children further to tell from their own observation that at a certain part of the day they always see **one side of the playground,** *or of some well-known street,* **in the sunshine**; *later on it is* **the other side** *that is* **lighted up.**

3. We have learned then that the sun is not always in the same part of the sky. Look at the sky, and see if you can point out where the sun was, when you went home at twelve o'clock.

Assist them in this, and explain that the sun is **always in that part of the sky at twelve o'clock** *in the day. Notice that it is not there now, and lead the children to tell that it is* **not so high** *in the sky now, as it was at twelve o'clock.*

4. Who has watched the sun in the evening, just before it begins to get dark?

Is it high up in the sky then, or low down? It is **low down,** quite close to the earth, where the earth and sky seem to meet and touch.

What do we call that part of the sky? **The horizon.**

What becomes of the sun after that? It **sinks down below the horizon.**

What happens then? The light dies away little by little, and the **dark night comes on.**

When do we see the sun again? **Early the next morning.**

Is it high in the sky then, or low down as it was the evening before? It is **very low down.**

5. *Explain that it comes up little by little from below the horizon,* **just as we see it disappear in the evening.** *Picture it as it comes gradually into view. Sketch the rising orb on the blackboard, in its different phases.*

Suppose some one sat all night, and watched the spot where the sun went down. Would he see it come up next morning in the same place? No; we always find the sun **in another part of the sky** in the morning.

6. *Explain that, if the watcher wished to see the sun come up in the morning, he would have to turn his back to that part of the sky where it went down; for* **it comes up on the opposite side of the earth.**

7. N.B.—*The teacher should take the opportunity at this stage of impressing upon the children, in as simple a way as possible, that these* **apparent movements of the sun** *are after all* **only an illusion,** *although too much must not be made of it now, as it is a difficult subject for young children to grasp, and will be dealt with to more advantage later on, when the rotundity of the earth has been taught.*

For the present it is best to meet them on their own level, and to be content with one step at a time.

Ask some child, who has been in a railway train, to describe what he saw, when he looked out of the carriage window at the houses, trees, and tall poles by the side of the line.

Lead him to tell that—

(*a*) *These things* **seemed to be rushing past in the opposite direction** *to that in which he was going.*

(*b*) *When he looked at them, he* **almost forgot that he was moving** *in the train, and* **they were standing quite still.**

8. *Tell that it is exactly the same with the sun.*

The sun seems to move across the sky in one direction, but in reality **it does not move at all**; it is **the earth** on which we live **that moves,** and it moves **in the opposite direction.**

Promise to tell them more of this another time.

IV. East and West

1. *Fix the wire ring in position now behind the table, and slowly and gradually move the ball up from below.*

This represents the sun, as it **seems to come up from below the horizon** in the morning. We say **the sun is rising.**

Move the ball along the ring, and show that as it moves it is getting **higher and higher.** *When it reaches the highest part of the ring, measure with a tape, and show that* **it has made half its journey.**

The sun in the same way mounts **higher and higher**

in the sky till twelve o'clock in the day. At twelve o'clock it is at its **highest point** in the sky, and we say it is **noon.**

That part of the day **before twelve o'clock** is called the **forenoon.** Why?

2. *Now move the ball slowly and gradually along the other half of the curve, pointing out that as it moves it is getting* **lower and lower down,** *and at last let it disappear altogether below the edge of the table.*

After twelve o'clock **the sun sinks gradually lower and lower,** and at last in the evening it passes away out of sight **below the horizon.** We say **the sun sets.** What do we call that part of the day after twelve o'clock? Why?

3. *It would be well to let the children see the ball pass along the lower part of the ring, and return to the horizon once more. This could be easily done by loosening the spring clips one by one.*

4. *As the ball comes up into view, tell that the part of the sky,* **where the sun rises,** *is called the east.* We say **the sun rises in the east.**

Now pass it slowly along the arch to the opposite end, and let it disappear once more.

What do we say the sun does when it sinks down like this? We say **the sun sets.**

Explain that the part of the sky, **where the sun sets,** *is called the west.* **The sun sets in the west.**

N.B.—*The teacher would do well (in preparation for the later lesson) to make this arch, and the imaginary journey of the sun along it, and more especially the position of the sun at noon, subjects for daily observation by the class.*

The sun streaming in at a certain window—always the same one—just as the class is being dismissed at twelve o'clock, or shining over some fixed object in the playground as they run off home, would thus become a familiar sight to all.

Summary of the Lesson

1. The sun is a great round ball of fire.
2. The clouds are nearer to us than the sun.
3. The sun rises in the east every morning, and sets in the west every evening.
4. The sun is at its highest point in the sky at noon.

Lesson X

SUNSHINE AND SHADOW

The teacher will require a small paraffin lamp, and a spike, or stick of some sort, capable of being set up erect on a flat disc for observation from time to time.

I. How Shadows are formed

1. *Pull down the window-blinds, so as to shut out the daylight as far as possible, and then light the lamp. Notice that the lamp at once sheds its light in all directions, so that the room instead of being dark is now lighted up.*

Why is this? Because the air is transparent; **light can pass through it.**

Now stand one of the children in the middle of the room, and hold the lamp behind him. Call the attention of the class to the **dark patch on the floor,** *which begins at the child's feet, and* **stretches across the room in front of him.**

Point out that it is something like the boy in shape, only very much bigger.

2. What do we call this dark patch? We call it a **shadow.** It is **the shadow of the boy.**

Why does the lamp throw the boy's shadow on the floor? Because the boy's body is **opaque.** The **light cannot pass through it,** as it does through the transparent air all round.

3. *Show that his body actually stops the light from passing to that part of the floor, and so* **a dark shadow remains there.** *Hold the lamp in front of the boy, and let the class observe that the shadow is now* **behind him.** *Hold it on one side, and* **show the shadow on the other,** *and so on.*

Let the boy walk across the room, and the class will see that **the shadow moves as he moves.**

4. *Lead them next to describe, from their own observations, the shadows cast by the firelight, and by the gas-lamps, and the lighted shop windows in the streets.*

Hold up a variety of objects, and point out that—

(*a*) **They all cast shadows** *if they are opaque.*

(*b*) *The shadow is in every case* **similar in shape to the object** *which casts it.*

5. *Call attention to the length of the boy's shadow on the floor, and while doing so gradually raise the lamp, and let him walk slowly towards it.*

What do you observe now? As the lamp is raised higher, **the shadow gets shorter and shorter.**

Notice what happens when I hold the lamp directly over his head.

Where is the shadow now? There is **no shadow at all now.**

Hence we see from this that **when the lamp is low the shadows are long, when it is high the shadows are short.**

II. The Sun and its Shadows

1. We will put out the lamp, and draw up the blinds now, for we are going to talk once more about the **great lamp that shines in the sky**—the sun.

When the sun is very bright and hot, where do we like to sit? In a **cool, shady place.**

Where do we find these cool shady places? Under a tree, or by the side of a wall **where the sun is not shining.**

Why is the sun not shining there as well as in other places? Because **the tree and the wall are opaque**; the sun cannot shine through them. It **casts a shadow of them** on the ground.

2. *Point out that it is cool as well as shady there,* **because the heat of the sun, as well as its bright light, is shut off.**

Tell that the sun (like our lamp) casts shadows of every opaque object on which it shines, and lead the children to tell that on a bright, sunny day, they always **see their own shadows on the ground** *as they walk along—sometimes in front of them, sometimes behind them, and sometimes at their side.* Sometimes the shadow is sharp and well defined, sometimes it is blurred. Why?

3. *Refer to the experiments with the lamp, and ask them to* **measure one another's shadows** *in the open air at different times in the day.*

Remind them that when the lamp was low the shadows were long, when the lamp was high the shadows were short; and explain that they will find it exactly so with the sun.

At what part of the day is the sun highest? **At noon.**

What sort of shadows would you expect to find then? **Short shadows.**

When would you expect the shadows to be long? Just before sunset.

Why? **Because the sun is then very low down in the sky.**

4. N.B.—*This lesson, like others of a similar nature, depends for its full development upon constant observation.*

It would be well to note, by the aid of a spike set up erect on a flat disc, the varying length of the shadow at noon throughout the year.

For the present, and during the lesson, the teacher must of course be content with simple explanation, but he would have

ample opportunity of verifying his statements, by observation of the spike and its shadow from month to month.

The noon shadow in the summer-time is **much shorter than it is in the winter.**

What does this tell us? It tells us that the sun at noon is **higher in the sky in the summer** than it is in the winter.

III. Short Shadows, Long Days

1. *Draw an arc on the black-board showing the position of the sun at noon, and also its position at sunrise and sunset.*

This curved line represents the great arch in the sky

along which the sun seems to travel from east to west.

We found just now that the sun is **not so high at noon in the winter** as it is in the summer. We will let this other curve represent the sun's winter journey. At noon, you see, the sun is still in the same part of the sky, **exactly in the middle of the arch,** but it is lower down than it is in the summer.

Let us measure these two curves from the middle of the arch both ways. The **upper curve is longer** than the other.

What does that mean? The sun has farther to travel in the summer than in the winter.

2. *Be careful to impress upon the children that* **the sun must reach the top of the arch** (*the middle of the journey*) **at noon,** *or twelve o'clock, every day whether it be summer or winter.*

Then as it has farther to travel to get to the top of the arch in summer than in winter, what must it do? **It must start earlier.**

What do you mean by that? **It must rise earlier.**

Explain that the sun does actually rise earlier—much earlier—in the summer than in the winter. **It rises hours before we are out of our beds.**

Proceed to show next that, after it reaches the top of the arch at noon, the other half of the journey remains to be done.

The part of the day **from noon to sunset** is as long as the other part **from sunrise to noon.** In the middle of summer the sun **rises at about a quarter to four** in the morning, and **sets at about a quarter past eight** in the evening, making a very long day of sixteen hours and a half.

IV. Long Shadows, Short Days

1. *Call attention to the other curve now. Remind the children that this represents the sun's winter journey, and that, as before, the sun must be exactly at the top of the arch at noon.*

Point out that, as this winter journey is so much shorter than the summer one, it is not necessary to start so soon. **The sun rises much later in winter than in summer.**

Point out too that the second half of this journey from noon to sunset is as short as the first half.

The sun sets much earlier in winter than in summer.

2. *Tell that it is not easy for little boys and girls to see the sun rise or set in the summer, as it is up hours before they are out of their beds, and it does not set till long after their proper bed-time in the evening.*

But in the middle of winter (say on Christmas Day) every one may see both sunrise and sunset, provided it be a clear,

bright day; for the sun does not rise then till about **eight o'clock in the morning,** *and it sets* **just before four o'clock in the afternoon,** making a very short day of less than eight hours.

As a matter for further observation in connection with this subject, the teacher would do well to note as far as possible the objects over which the sun is seen to rise and set from month to month.

Summary of the Lesson

1. Opaque things cast shadows, because light cannot shine through them.
2. When the sun is low in the sky the shadows are long; when the sun is high the shadows are short.
3. The noon shadows in summer are shorter than they are in winter.
4. The sun rises earlier and sets later in the summer than in the winter, and it also mounts higher in the sky at noon.
5. That is why the days are longer and warmer in summer than in winter.

Lesson XI

CLOUDS

Provide the teacher with Brown's pictures of the different kinds of clouds. A small kettle and tripod stand, and either the Bunsen burner or a spirit-lamp, will also be required.

I. Introduction

This lesson, from its very nature, like others of its kind, would have more interest for the children if a suitable day were selected for it, because then they would have actually before their eyes all the phenomena with which it deals.

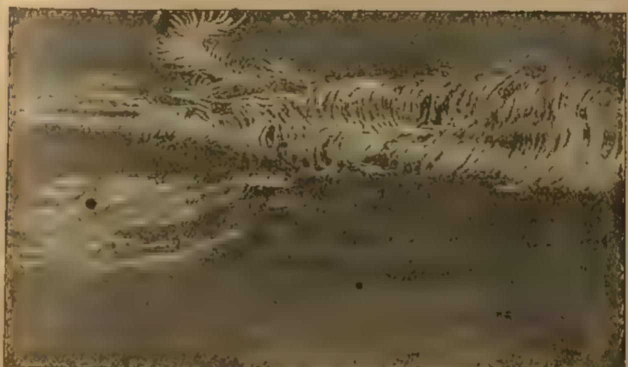
With the rain falling fast outside, then, the teacher would naturally commence by making some remark about the wet day.

Boys and girls do not like wet days. They cannot play outside, but must remain in the house. Mother sends them to school with strong boots, thick coats, and umbrellas, so that they may not get wet.

But the rain is very useful to us in many ways. Suppose we try to learn something about it to-day.

II. Form of Clouds

1. Where is the rain coming from? **From the clouds.**



FEATHER CLOUDS.

Where are the clouds? The clouds are **in the sky.**

What colour is the sky to-day? It is **a dull grey** colour.

Is it always this colour? No; it is sometimes **a beautiful blue** colour.

What do we then say about the sky? We say it is **a cloudless sky.**

Why is it dull and dark now? Because it is **covered with clouds.**

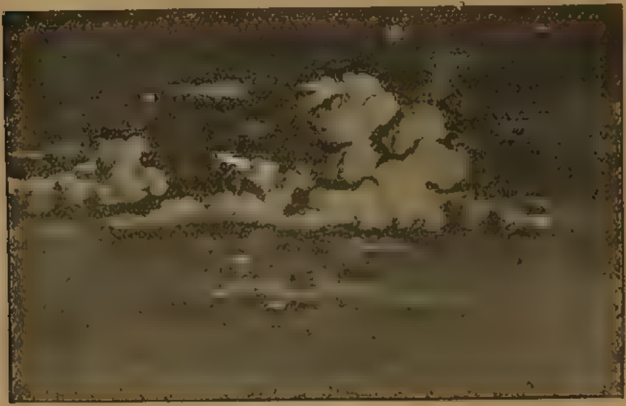
Lead the children to tell that the clouds are piled up so thick and close together to-day, that **we cannot see the sun's bright light through them,** *nor feel*

any of its warmth. The clouds shut it away from us altogether.

We call clouds of this kind **rain clouds.**

2. But the clouds are not always the same as we see them to-day. It is only in rainy weather that they **cover the sky** as they do now.

We can almost always see **little white patches of cloud** dotted over the blue sky on a clear, bright day,



HEAP CLOUDS.

and they look like patches of **loose white wool** or **feathers.** Clouds of this kind are known as **feather clouds.**

3. Sometimes, although the weather is fine, we see **great curly masses of thick dark clouds** moving across the sky. These are called **heap clouds.**

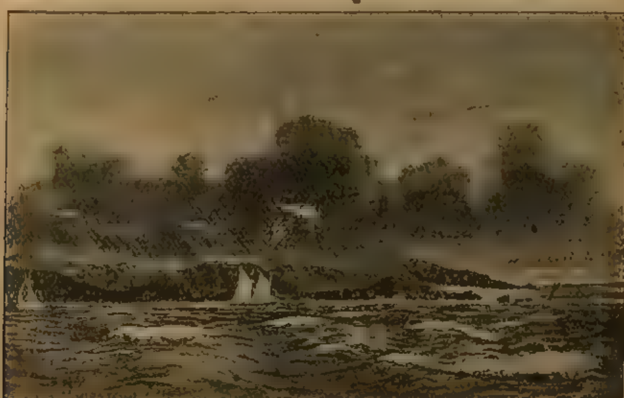
4. Sometimes too the clouds, instead of being piled up in curly masses, **stretch across the sky, low down, in beds or layers** These we call **beds of cloud.**

Show pictures of these different clouds if possible.

5. Then too we sometimes see a great black cloud, as

LAYER CLOUDS.

black as ink, come up and spread itself out, till it covers the whole sky. Then all of a sudden there comes very



STORM CLOUDS.

heavy rain, and perhaps lightning and thunder with it. This we call a **storm cloud.**

Remind the children that the rain from the grey clouds, which they can see in the sky now, has been falling all day long. The rain from those **inky black clouds,** *although very heavy, is soon over. We call it* **a storm.**

III. What Clouds are made of

Now I daresay you would like to know what the clouds are made of. I will make a little cloud for you, and then you will be able to see for yourself what a cloud is like, and what it is made of.

1. *The kettle, which to save time has been simmering all this while somewhere out of sight, should now be brought forward, and made to boil over the spirit-lamp or the Bunsen burner.*

Call attention to something new coming out of the spout.

What is this called? What colour is it? What is there inside the kettle? Where did this steam[1] come from?

The steam, which you see coming out of the spout, is made from the water in the kettle. **It is a little cloud.**

2. What has changed the water into this little cloud of steam? The **heat** of the flame.

How long will the steam rush out of the spout in a

[1] Of course it is not absolutely correct to call this white cloud steam, for real steam is invisible. But here we have another instance where it is better to meet children on their own platform, and be content with taking one step at a time. They know it as steam. Further explanations can come later on.

cloud like this? Till all the water in the kettle **has boiled away.**

3. Now I want you to notice what happens when I hold this wet slate in front of the fire. You see there is **another little cloud rising from the slate,** just like the steam which is coming out of the spout of the kettle.

What is causing this? The **heat of the fire** is changing the water on the slate into **a cloud.**

How long will this go on? **Till the slate is quite dry.**

4. Do you know what would happen if I stood the wet slate out in the hot sun? The slate **would soon get dry.**

Why would it get dry? Because **the water on it would be changed,** as the water on this one was, and then it would **fly away in a cloud.**

What would change it? The **heat of the sun.**

Yes; heat always changes water into the form of cloud.

Compare this with the drying of the wet clothes, hanging on the line on washing-day.

Tell of the sun's great heat, and its action on water everywhere. It acts just as it would on the wet slate and the wet clothes. This is how all the clouds in the sky are formed.

IV. Why the Clouds float in the Sky

1. Watch the steam as it still pours out from the spout of the kettle.

What becomes of it? It **rises** and **floats away** up to the ceiling.

I will now tilt the kettle till some of the water flows out at the spout.

What becomes of the water? Does the water float up into the air in the same way? No; the water flows or **pours down** into the basin.

Why does the steam rise and float about in the air? Why does the water flow down?

2. *Remind the children of their little toy ship floating on the water* (Lesson VII.). *Lead them to tell that things float in water because they are lighter than the water. Be careful to impress upon them that*—

(*a*) Such things float **because the water is heavier than they are; it presses upon them and forces them up.**

(*b*) Stones and other things sink, **because the water is lighter than they are,** and cannot press upwards with as much force, as the weight of these things presses downwards.

3. Let us next find out what all this has to do with the cloud of steam from the kettle. We have seen the steam float up in the air just as other things float in water.

Can you tell me now why it floats? **Steam** must be **lighter than air. The air presses upon it and forces it up.**

And why does the water from the spout pour or flow down? Because water is heavier than air, and the air cannot hold it up; the water sinks through the air, **just as heavy things sink through water.**

Then why do the clouds float in the sky? Because they are lighter than the air; **the air pushes them up.**

Summary of the Lesson

1. There are feather clouds, heap clouds, layer clouds, and storm clouds.

2. Heat changes water into cloud.

3. Clouds float in the sky because they are lighter than the air.

4. The heavy air presses the light cloud up.

Lesson XII

THE WIND

The teacher will require a couple of elastic bladders, and the contrivance described below in Section IV. for producing a current of air.

I. Introduction

Selecting, in this case again, if possible, a suitable day for the lesson, the teacher would begin with some remarks about the weather. The wind roaring outside, or whistling down the chimney, or swaying the branches of the trees to and fro, would naturally serve as a pretext for calling attention to what was going on.

What is the meaning of all this noise? or, Why are the trees bending over from side to side like this? The wind is doing it all. Let us see what we can learn about the wind.

II. What Wind is

1. Look how the blind is flapping about at the open window. Is the wind doing that too? Yes.

But where is the wind? I cannot see it. I can see the blind moving about, but I cannot see the thing that is moving it. Can you see it? No; **we cannot see the wind itself**; but we can see the things sway about, as the wind pushes up against them.

What do we say the wind does to the things? **It blows them about.**

2. *Lead the children to tell how the wind blows their clothes about, and snatches their hats and caps off their heads, as they run to school. They cannot see anything near them, but all in*

a moment their hats are blown across the road, and they have to run after them to get them again. **We cannot see the wind itself,** *but we can see what it does.*

3. *Let them tell further that, although they cannot see the wind,* **they can feel it blowing in their faces,** *and all round them. It sometimes blows so hard against them that it makes them run; and it sometimes knocks them down. It is sometimes so strong that it breaks off the branches of the trees, and even blows trees down.* **We can feel the wind, although we cannot see it.**

4. But in this warm schoolroom, and in our beds at home, we cannot even feel the wind, and yet we know it is blowing. How is this? **We can hear it.**

Tell how the wind roars and howls round the house at night; how it rustles among the leaves and branches of the trees; how it whistles through the key-holes of the doors, and down the chimneys. We hear all this. Our ears tell us what our eyes cannot tell us. **We can hear the wind, and we can feel it, but we cannot see it.**

What can this wind be, which we hear and feel, and yet cannot see?

5. *Remind the children of their lesson on Air, and lead them to tell that there is* **air everywhere**—*that there is air in this room, although we do not seem to know it is here; we do not feel it,* **till we wave our hands about through it.**

What did the air do to the pieces of paper and the feathers when we waved the fan to and fro near them? It **blew them about.**

What did it do to the little toy ship on the water? It **blew the ship along.**

Explain that in both cases **we made the air itself move,** *that it was the moving air which moved the other things, and then tell that* **when the air moves about** in this way **we call it wind.** Let us find out next how winds are made.

III. Warm Air rises

1. *Take two small elastic bladders and partly inflate them with air. Then after tying the mouth of each securely, call some child to the front, and let him hold one of them by the string in front of the class, the teacher holding the other in a similar way near the fire.*

Notice that the one in front of the fire soon begins to swell up, and become much bigger than the other. Tell the reason why.

The air inside this bladder has been heated, and the heat has made it spread out and fill the bladder. **Air always spreads out when it is heated.**

2. *Notice too that this bladder now seems to want to rise and float in the air, and point out that it did not attempt to rise, when it was first held in front of the fire. The other one held by the child hangs at the end of the string without any signs of rising.*

Let us try to find out the reason for this.

Why does the steam from the kettle rise and float in the air? **Because it is lighter than the air,** and **the air forces it up.**

The children will be easily led to infer from this that the bladder which wants to rise **must now be lighter than the air,** *or the air could not force it up. Why should this one be lighter than the other?*

Explain that air not only spreads out when it is heated, but it also becomes lighter, **because the same quantity has to fill a bigger space.**

The warm air inside this bladder is lighter than the air of the room; the heavier air of the room is trying to force it up.

IV. How Winds are made

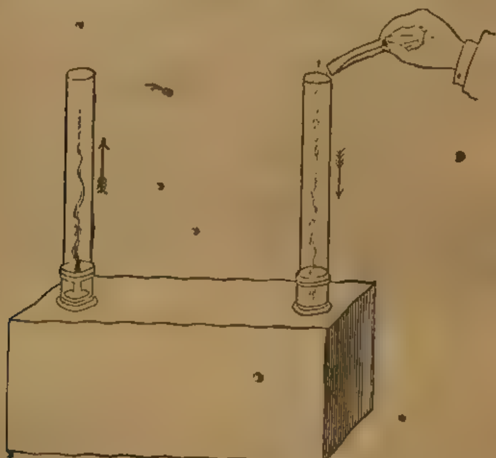
1. *A very simple little contrivance will now make the whole*

thing quite clear to the children. A small wooden box and a couple of lamp-glasses will be all that is wanted.

Such a box could be easily obtained from the grocer or provision dealer. A baking-powder or blacking box would do admirably.

Have the lid removed, and cut a couple of round holes in the bottom, near the ends, exactly the size to receive the two lamp-glasses. Fit the glasses into the holes, and place a lighted candle under one of them.

2. *As the candle burns, hold a piece of burnt paper, or some*



other very light substance, over the top of this glass, and at the same time let one of the children hold a piece of smouldering rag over the top of the other.

Two things will now be clearly seen. The smoke from the smouldering rag **will be drawn down the one glass,** *and the light substance held over the top of the other* **will be carried upwards.**

Why is the smoke passing down this glass? Why are the little bits of burnt paper flying up from the other?

It is **the air which is moving,** and it makes these other things move.

We must find out why the air is moving.

Elicit that the flame of the candle must make the air inside the glass hot and light—**much lighter than the air of the room**—*and then the rest will be easily deduced.*

The air inside the box itself, as well as the air in the room, is heavy, and **this heavy air is pressing against the light air in the glass,** and forcing it up.

All the time the candle is burning in one glass, air from the room is constantly rushing down the other **to push the light air upwards.**

3. *Explain that we have been making a wind in the box—we have been* **setting the air in motion.**

All winds are caused by the air in some particular place getting very hot and light, and then **the colder, heavier air near it presses upon it, and forces it to move.** It is a struggle between the heavy air and the light air, and the heavy air wins by forcing the light air away.

Summary of the Lesson

1. Wind is moving air. We can feel it, although we cannot see it.
2. Warm air rises, because it is lighter than cold air, and the cold heavy air forces it up.
3. When the air moves, it moves other things. We say the wind blows them.

Lesson XIII

CLOUDS AND RAIN

Provide a small flask, the Bunsen burner and tripod stand, a jug of water, a glass prism, and Brown's Picture of the Rainbow

I. Rain from the Clouds

1. *Boil some water in a flask over the Bunsen burner or the spirit-lamp, and as the cloud flies off from the boiling water, call special attention to the fact that there is nothing at all to be seen in the mouth of the flask itself, and for some little distance above it.*

The cloud does not show itself till it reaches the air of the room.

Hold one hand in this cloud, and pass the other (rapidly of course) between the cloud and the mouth of the flask.

Why did I draw my hand back so quickly? Because the steam would scald it.

But I cannot see anything at all round the top of the flask. There is a big cloud just above it, where I am still holding my other hand, but that is not being scalded. Where is this scalding steam?

2. *Explain that the steam, when it first rises from the boiling water,* **is as hot as the water itself.** *It would scald us badly. That is the real steam, and* **we cannot see it** *as it comes from the flask,* **because steam itself is invisible.**

Hold a cold slate in the midst of it, and show that it **turns into actual water again,** *as soon as it touches the slate. Call attention to the drops of water, as they trickle down it.* **Steam changes into water as it cools.**

The white cloud, in which I am still holding my hand, is steam that is **already changing back into water.**

We do not see it till it begins to change, and then **it is no longer actual steam.** This little cloud is not really steam, but **water-vapour.**

It is **water-vapour,** not steam, that we see flying out **from the funnel of the railway engine.** It is **water-vapour** that **forms the clouds** in the sky.

The air of the room, although not cold enough to change this steam into drops of actual water, is sufficiently cold **to make it begin to change,** *and in that state it becomes* **water-vapour which we can see.**

Hold the hand again in the cloud above the flask for a short time, and let the children see that, when it is removed, **it is quite wet. The water-vapour has made it wet.**

3. This water-vapour is **so much lighter than air,** that the air forces it up, and **it floats about in the sky as a cloud.** But when it gets cold, the little particles of vapour run together, and are **changed back again into water,** just as we saw them changed on the cold slate.

Water is heavier than air, and therefore cannot float in the air. It sinks, and **falls down to the earth as rain.**

II. The Wind and the Clouds

Pass on next to consider the clouds in the sky once more. They are not all the same shape and size. They are always changing. Sometimes they are in **little patches,** *sometimes they are* **piled up in great heaps.**

They do not always remain in the same part of the sky. They move about, and **it is the wind that blows them about in the sky.** *We may sometimes see the clouds* **driving onwards** *so quickly, that they almost look* **as if they were chasing one another** *through the sky.*

Then we see **one cloud break into another,** *and change its shape, as they drive on together. Sometimes they move slowly; sometimes they scarcely seem to move at all. Elicit as much of this as possible from the children's own observation.*

The wind does it all. It drives the clouds from one part of the sky to another. **The rain does not all fall in one place.**

III. Rain-Drops

Lead the children next to describe, in their own way, how the rain falls.

It does not fall in streams, as they have seen water come out of a spout or a tap. **It always falls in little drops.**

Dip a stick in a tumbler of water, and hold it up for the children to see the drop of water hanging at the end of it.

Shake the stick, and ask them to describe the shape of the drop of water that falls from it.

It is **round like a ball.** It is **a little round ball of water.** The rain always falls in little round balls of water like this. We call them **rain-drops.**

N.B.—*It would be well, in connection with this, and on the first opportunity, to catch a few rain-drops on a dusty board, so that the children may note for themselves* **the size and shape of the drops,** *as they roll about in the dust.*

IV. The Rainbow

The phenomenon of the rainbow should form an interesting sequel to this subject, but of course it will require the simplest of treatment, and, if possible, it should be taught from actual observation.

1. **Observation.**—*Rainbows are often seen* **in the spray of cascades** *and* **fountains,** *when the sun is shining on them; and in suitable weather it is easy to make a bow* **with an ordinary garden-hose** *during the watering operations. Under favourable conditions the thing might even be done in the playground with the help of the school-keeper's flushing-hose.*

In either case, the hose should be fitted with **a fine rose-nozzle,** *and the experiment should take place* **on a bright, sunny afternoon,** *and* **as late in the afternoon as possible.**

When all is ready, turn on the water and play the hose high, so as to cause the falling drops of water from it to **pass through the direct rays of the sun,** *and a rainbow will at once appear.*

Call attention to the succession of colours—**red, orange, yellow, green, blue, indigo, violet.** *When there is only one bow,* **the red arch is above** *and the violet below. But sometimes there are two, and then the colours are reversed.*

Notice that the bow is **directly opposite the sun**; *that the sun is behind us as we look at the rainbow.*

2. **Explanation.**—*Let one of the children hold a glass prism in the sunlight now in front of a sheet of paper, and show that we get* **the same seven colours, in the same order.**

Tell that these colours are formed by the sun shining on the glass, and on the drops of falling water.

Remind the children of the shape of the drops of water. They are always round, or **ball-shape.**

Tell that it was **the roundness of all those little balls of water** *which gave our rainbow its beautiful arched shape. It is* **the roundness of the rain-drops,** *which fall from the clouds, that makes the rainbow in the sky.*

On the first fitting opportunity that follows be careful to point out that the position of the rainbow is not always the same. It is **sometimes very high** *in the sky,* **sometimes low down** *near the earth.*

Tell that the **nearer the sun is to the horizon** *the larger and higher will the rainbow be.*

Rainbows are **only seen in the morning and evening**—never when the sun is high up in the sky as it is at noon.

Summary of the Lesson

1. Vapour changes again into drops of water when it gets cold.

2. Water is heavier than air. The drops of water cannot float in the air. They fall as rain.

3. The wind blows the clouds about from one part of the sky to another. Hence the rain does not all fall in one place.

4. Rainbows are formed by the sun shining on the round rain-drops, as they fall from the clouds.

Lesson XIV

WHAT BECOMES OF THE RAIN

The following articles will be required for illustration: a towel, a large dry sponge, a piece of sea-weed, and some damp salt. A saucer of water should also be placed on a shelf in the room, a day or two before the lesson, and the attention of the children should be called to it at the time.

I. Some of it flows away

Picture a heavy shower, and lead the children to tell, from their own observation, how **the rain-water collects in the**

gutters *at the sides of the road, and* **flows away towards the drains.**

Point out that the heavier it rains, and the more the ground slopes, **the faster the water flows.** *We can see how fast it flows by dropping a piece of stick, cork, or paper into it.*

Why does the water flow along the gutter in this way? Because water is a liquid, and liquids cannot flow up: they always flow down to the lowest level.

Do not go beyond this for the present.

II. Some of it sinks into the Earth

1. Now let us think about the garden-beds after a shower of rain.

We go out when the rain is over, and we find it is nearly all gone.

What becomes of it? It **sinks into the ground.**

Why does it sink into the ground? **Because the ground is porous.** The water soaks through its pores.

2. *Point out that this does not take place only in the soft soil of the garden-beds—that* **even the hard gravel paths and the roadways are porous,** *and allow the rain to soak into them.*

We see **puddles of water standing everywhere** after the rain, but they sooner or later disappear, and some of this water soaks into the earth. It does not disappear so quickly on the paths and roadways, as it does on the garden-beds, because they are not so porous as the soft soil—that is all.

In some places we see **puddles of water standing for a very long time.** The water cannot soak into the earth. Why is that? Because the ground there is made of clay, or something like it, which is not porous, and **will not let the water pass through.**

III. Some of it becomes Vapour

1. *Dip a towel in water, wring it out, and hang it in front of the fire.*

Dip a slate in water, and let one of the children hold that in front of the fire too.

What do you see? **A little cloud** rising from the towel and the slate.

What does that mean? It means that the water which wets them is being **changed into water-vapour**; the water-vapour makes the cloud which we see.

How long will the cloud rise like this? Till the towel and the slate become dry again, and there is no more water in them to change into vapour.

2. *Compare the towel to the* **wet clothes hanging out to dry on the clothes-line,** *and the slate to the* **roads and pavements after a shower of rain.**

Both get dry, because the water in and on them passes off in the form of **water-vapour,** which floats away in the air.

Watch the cloud of vapour rising from each of them. We lose sight of it as it floats away in the air. Let us find out next what really becomes of it.

3. *Dip a dry sponge in water, and let the children observe and tell that it very quickly* **sucks up or absorbs every drop of the water.** *It is* **porous.**

Explain that the air acts very much in the same way as the sponge. **It sucks up or absorbs water-vapour,** *as greedily as the sponge sucks up water.*

The wet clothes on the line and the wet pavements after the rain become dry, because the water which wets them **is changed into vapour, and the vapour itself is sucked up by the air.**

IV. Vapour in the Air

1. *Point out that we saw the vapour when it first rose from the wet towel and the slate, but we lost sight of it as the air absorbed it,* **because the particles were so scattered through the air, that they became invisible.**

There is always some moisture in the air, although we cannot see it. Wherever water is exposed to the air, **it changes little by little into vapour,** and the vapour is **sucked up by the air.**

2. Sometimes more vapour rises than usual, and we then see it in the air all round us, in the form of **fog or mist;** but when there is only a small quantity of vapour in the air, it becomes scattered and **the wind blows it away to form clouds in the sky.**

We see this water-vapour in the sky again as cloud, because as it gets colder and colder **it collects in dense masses.**

Much of the rain which falls to the earth disappears in this way. It is **changed into vapour,** and **absorbed by the air** to form either **mist, fog,** or **cloud.**

3. *Point out that sometimes the wet clothes and the wet pavements dry very quickly, and at other times they remain wet for a long while.*

Why is this? Let me show you.

Wet the sponge thoroughly, and stand it in a saucer of water as before, calling upon the children to tell what they observe.

What happens this time? **The water does not leave the saucer,** and pass up into the sponge as it did before.

Can you tell me why? **The pores of the sponge are full of water; it can hold no more.**

4. *Explain that it is exactly so with the air.* **Sometimes the air is dry,** *and it then* **sucks up the water-vapour**

very quickly. *When this is the case the wet clothes and the wet pavements soon become dry.*

Sometimes the air is so full of moisture that **it can hold no more,** *and then the clothes and the pavements remain wet for a long time, because the air cannot suck up the water-vapour from them.*

5. *Take down the saucer from the shelf now, and explain that when it was put on the shelf* **it was full of water.**

The saucer is now quite dry. What has become of the water? It has been **changed into vapour,** and **sucked up by the air.**

What shall we say then about the air of this room?

The air must be dry, **because it sucks up moisture** quickly.

6. *It would be interesting to keep a* **piece of sea-weed** *hanging up in the schoolroom, so that the children might note for themselves the changes that take place in it from time to time. One of the long ribbon-like leaves, that are so plentiful on the sea-shore, would be best for this purpose.*

In dry weather *the leaf appears* **hard and stiff;** *when the* **air is moist** *it is* **soft and pliant.** *Tell the reason for this, and, as a further illustration of the same phenomenon, show a piece of salt that has been kept in a damp place.*

Summary of the Lesson

1. Some of the rain flows away in streams down the gutters.
2. Some of it sinks into the earth.
3. Some of it changes into vapour, and floats away in the air to form clouds.
4. When the air is very dry it sucks up water-vapour very quickly.

Lesson XV

SALT WATER AND FRESH WATER

Provide for illustration: two evaporating dishes, tripods, and Bunsen burners, two tumblers, one full of brine, the other of drinking-water, some rock-salt and common table-salt, Brown's Picture of the Salt-mine.

I. Making Clouds again

1. *Place two evaporating dishes on tripods side by side. Into one pour a little* **ordinary drinking-water,** *and into the other some* **strong brine,** *and proceed to boil each over the flame of the Bunsen burner or the spirit-lamp.*

Call attention to the little **clouds of vapour** *which rise from them, and lead the children to tell all they can of the process which is going on before their eyes.*

2. *When the boiling is all over, take the first dish, and show that it is* **quite dry now,—all the water has disappeared.** *Let one of the children run his finger round the inside of the dish to prove this. He finds the dish quite dry and clean.*

Now call attention to the inside of the other dish.

What is this **white powdery stuff** all round the sides of this dish?

Let a boy rub some of it off with his finger.

There was no such powder left behind on the other dish. What can it be?

3. *Ask the boy to put his finger to his tongue, and tell what he discovers.*

This white powder **tastes salt.** It is just **like the salt we use at our meals.**

Explain that it is **really salt**; *and then puzzle the chil-*

dren by pointing out that nothing was put into the dishes to be boiled but clear water from the two tumblers, which still stand on the table.

Where can this salt have come from then?

4. *Let one of the class dip his finger into each of the tumblers now, and put it to his tongue—taking care to see that the fresh water is tested first, the brine afterwards.*

He will, of course, find that the water in this tumbler tastes salt—it is very different from the water in the other tumbler.

Explain that this water is salt, **because there is salt in it,** *and then ask the children to try and find the salt.*

The salt **cannot be seen in the water,** although we know it is there, for **we can taste it.** This is a puzzle. What can it mean? Let me show you.

5. *Break up some salt and put it into the first tumbler. Stir it well, and let the children watch it* **gradually disappear.** *When nothing is to be seen, and the water is clear again, let the children taste it.*

This water is salt now, just like that in the other glass. The salt, which we put in, has broken up into such tiny bits, that they **cannot be seen in the water.** The salt has disappeared, although we know it is there, because we can taste it.

6. *Dip a little splinter of wood into the water, and let the children taste the tiny drop, which hangs from the end of it.* **Even this tiny drop of the water tastes salt.**

Deduce from this that, the salt must have been broken up, and scattered **into every particle of the water.**

We say **the salt is dissolved.** It is this dissolved salt in the water, that **makes the water salt.**

7. *Lead the children to compare this with the disappearance of the* **sugar in their tea and coffee**; *and give other familiar examples to show that* **sugar, soda, alum, lime,** *and many other things* **dissolve,** *as well as salt.*

All these things which dissolve in water are said to be **soluble substances.**

II. Salt—What it is

1. Here is a piece of salt. Let us see what we can learn about it now.

Let the children handle and examine it, with a view of deducing that it is **a white, brittle, crumbling substance.**

Compare it with the specimen of **rock-salt.**

First lead the children to describe the appearance of the new substance. It looks like a piece of **pinkish-brown stone**; it is **hard, smooth,** and **shiny.**

2. *Let one of the children, in the next place, put his tongue to it. He finds that it is* **not really stone,** *for* **it tastes just like the piece of salt** *on the table.*

Explain that this is **really salt,** *and that because it is like stone or rock, we call it* **rock-salt.**

3. *Tell that deep down in the earth there are* **great solid beds** *of this* **rock-salt,** *stretching for miles.*

It is **dug out of the ground** like **clay, chalk, sand, slate,** and **stone.** It is a **mineral.**

4. Let us see what will happen if we put a piece of this rock-salt into a glass of water. See, the lump is getting smaller and smaller as I stir it about; it will soon disappear altogether.

What has happened to it? It has been **dissolved**; it is in the water **although we cannot see it.**

Tell now that things dissolved in water like this are said to form **solutions.** *We have here a* **solution of salt.** *Prove the existence of the salt as usual by tasting.*

Continue to add more of the rock-salt, and as it disappears let the children test the solution from time to time. They will

find that it gets **salter and salter** *in taste. We say the* **solution gets stronger.**

A **very strong solution** of salt is called **brine.**

III. Rock-Salt and Table-Salt

1. *Proceed next to boil some of this brine, made from the rock-salt, in the dish over the lamp or the Bunsen burner as before. When all the water has been driven off in vapour, show that there is something left behind,* **which we find to be actual salt by testing it.**

Notice, however, that this salt is **not like the hard, brown, shiny rock,** *which we put into the water. It lies at the bottom of the dish in little white grains.*

Be careful, too, to point out that every particle of the salt is left behind after the boiling. **Nothing but the pure water-vapour rises** *in the form of cloud.* **All the salt remains in the dish.**

2. Now let us go back, and think of those great beds of rock-salt which stretch for miles underground.

What would happen if water were always soaking through those beds of rock-salt? The water would **dissolve some of the salt,** and form **brine.**

Well, this is just what does happen. You know that every time it rains some of the rain soaks into the ground. Now, whenever it soaks into a place, where there are any beds of salt underground, it always dissolves some of the salt, as it soaks through, and so it becomes **brine.**

3. *Tell that the* **white, crumbly table-salt** *we use is obtained* **from this brine,** *by boiling away all the water, and leaving the salt behind, just as we did it in our little dish, except that the brine is boiled in great shallow pans as big as a room.*

But how is the brine itself got out of the earth?

Explain that men bore a hole through the ground into the

A SALT MINE.

bed of salt, and put a long pipe down the hole. The brine runs into this pipe and is **pumped up to the surface.**

4. In some places people **use the solid rock-salt,** instead of pumping up brine and boiling it. They have to **dig the rock-salt** out of great deep holes called **mines,** which they make in the earth.

Show a good picture of a salt mine.

It is a sort of underground town. The miners live there with their families, and rarely come up above ground. They cut out their houses, and even the stables for their horses, in the solid rock-salt. The horses never come up when once they are taken down there. They live, and work, and die in the mines.

On grand occasions the mines are lighted up to receive visitors, and the place then looks almost like fairy-land, for the shiny surface of the salt reflects the light in every direction.

IV. Salt got from Sea-Water

Show a glass of sea-water if possible. Say what it is and where it came from. Lead the children to tell, from their own experience and observation, and also by tasting the water before them, that **sea-water is salt**, *almost like brine.*

What happens to brine when we boil it?

What do you expect would happen to this sea-water if we boiled it?

Boil a little of the water in a dish as before, and let the children see and taste what is left behind.

Some people get all the salt they use **from sea-water.**

Summary of the Lesson

1. Salt dissolves in water. We cannot see it in the water when it is dissolved.

2. We can get the salt back by boiling the water.

2. Salt is a white, brittle, rough substance. It readily breaks up into grains.

3. It has a taste of its own, unlike the taste of anything else. It is soluble.

4. Rock salt is a mineral; it is dug out of the earth.

5. When salt is dissolved in water it makes a solution called brine.

6. Our table salt is made from brine.

7. Salt is also got from sea water.

SIMPLE OBSERVATION OF THE SURFACE OF THE LAND

Lesson XVI

TOWN AND COUNTRY

[illegible] Pictures, "In the Busy Town" and "In the Country," should be in readiness for the lesson.

The teacher should in every case make the school and its immediate surroundings the starting point for this lesson, and the daily run to and from school will provide the best of aid [illegible], for it must be remembered that the child's own little world is to a large extent contained within these limits.

Led by the teacher, his memory will be awakened and he will readily recall things which, till now, may have been passed by almost unnoticed. This in itself will have the effect of arousing and stimulating the faculty of observation, for it will show the child that there are objects of interest everywhere, if he will only use his eyes and look for them.

The country-bred child would afterwards listen with as much open-eyed rapt attention to the teacher's [illegible] word pictures of the town and its wonders, as the town child would to those which treat of the beauties and charms of the country.

The one thing to impress upon the child in either case is that, we live in a beautiful world, which is full of wonders. We ought to learn all we can about it.

I The Town

1. *The teacher in a town school might begin by asking several of the children in turn where they live, and which way they come to school, with the view of eliciting that they live in a certain street, and that they run along other streets to get to school.*

The natural inference from this is that there must be a great many streets near the school, some leading one way, and some another.

I want to see what you can tell me about these streets.

What do you see moving along the streets as you run to school? Horses and carts and waggons.

Do boys and girls and men and women walk on the same part of the street as the horses? No; we walk **on the paths at the sides of the street**; horses and carts keep **in the middle.**

What do we call this middle part of the street, where the horses walk? **The roadway.**

What name do we give to the path because it is paved? We call it **the pavement.**

Lead the children to distinguish between the broad, flat, pavement stones—the **flag-stones**, *and the solid blocks of stone—the* **curb-stones**—*which make the border or edge of the pavement.*

These curb-stones are made of a very hard kind of stone called **granite**—much harder than the pavement stones. Why?

2. What do we see on both sides of the streets? Long rows of houses built close together.

What else besides houses? Some shops.

Some of the streets are wider than others. What do we call them? **Roads.**

Do we find houses and shops there too? Yes.

What do you notice about the houses and shops in the wide roads? They are **bigger than those in the streets.**

Do we find most of the shops in the roads or in the streets? In the roads.

Why are all these shops needed? For people **to buy the things they want.**

Lead the children to infer from the number of shops and houses that, **there must be a great many people** *living near the school, and then remind them that, there are other streets and other roads stretching out on all sides, and that they too are full of houses, shops, and people.*

We call a place like this, where there are roads and streets packed close with houses and shops, **a town.** We live in a town. Do you know what it is called?

3. You have all seen the roads and streets after dark. What do they look like then? They are **lighted up**; it looks almost as bright as day.

Where does the light come from? It comes from **big lamps on the tops of tall iron posts.**

What do we call these posts? Where are they placed? Why are they so tall? Are there any other lights besides those on the tops of the lamp-posts? Yes; the shops are all lighted up.

Why? So that people may see the things in the shop windows.

Which are lighted best, the roads or the streets? The roads.

Why is that? Because there are **more shops in the roads** than in the streets, and they are much bigger.

4. You spoke just now of the carts and waggons that you meet with on your way to school. What do these carts and waggons carry? **Heavy loads of all kinds of things.**

Now think of the wide roads. What do you see moving along there besides carts and waggons? **Tram-cars, omnibuses, cabs** and **carriages.**

What do they carry? **They carry people.**

When do they run? They are running all day long to take people from one part of the town to another.

Which carry the greatest number of people? The **tram-cars.**

How many horses does it take to draw the omnibus? Two.

How many to draw the tram-car? Two.

Point out that the **tram-car is very much bigger and heavier** *than the omnibus, and carries more than twice as many people.*

How is it that two horses can draw this heavy car, as easily as they could draw an omnibus? Because **the tram-car runs on iron rails.** The wheels run very smoothly over these rails, so that **the horses can draw a much heavier load.**

We call the rails, on which the cars run, **the tram-lines,** or **tram-ways.**

5. *Before passing on, point out the natural inference that, as tram-cars, omnibuses, carriages, and cabs are running all day long to carry only people, there must be* **a very large number of people in the town.**

The troops of work-people *streaming out from* **some great factory** *(if there be one) in the neighbourhood, or* **the tram-cars filled with workers,** *going to or returning from their work, would enlarge upon this, and suggest that* **people live in the town, because their work lies in the town.**

Then, too, point out that these workers must have **homes to live** *in, as well as* **food, clothing,** *and* **other necessaries of life.** *Hence the number of* **houses** *and* **shops,** *and* **the crowded state of the marketing parts** *of the town.*

6. *Point out further that all the goods to be sold in the shops, as well as the things to be made in the factories, must be brought there, and the articles that are made must be carried away.*

Hence the number of carts and waggons *that we see.* **A town is a very busy place.**

II. The Country

1. *Show the picture, and proceed step by step to note the contrasts between the two scenes. It would be well to let the picture speak for itself, and lead the children, by means of a few careful questions, to seize upon one point after another.*

Comparing it with the picture of the town, elicit in the first place that, instead of the network of roads and streets, packed close with houses and shops, we have here nothing but the **green fields** *stretching away as far as we can see, and explain that the roads themselves are* **shady lanes,** *with* **hedges** *and* **trees** *on either side of them.*

2. *Call attention to the busy thoroughfare in the one picture, thronged with vehicles of all sorts, and people hurrying along in every direction, and then let the children point out that, in the other picture there are only* **two or three people** *to be seen* **working in the fields.**

Tell that there are **more people in one street** *of the busy town, than we should find in* **a long day's ramble through the country.** *Tram-cars, omnibuses, and cabs are never seen in these country roads. Why not?*

We might pass **a few carts,** and **a heavy lumbering waggon** here and there on the road, but we should not meet many people, for the few people that live there are busy in the fields.

3. *Point to the church spire peeping out among the trees in the distance, and explain that, if we walked across the fields towards the church, we should most likely find one long straggling street, with cottages dotted here and there, the school close by, and perhaps one or two little shops.*

This is where these country people live. We call the place **a village.**

4. *Explain that, if we could hear our two pictures, as well as see them, we should in one case be deafened with* **the constant noise, rattle,** *and* **bustle of the crowded streets,** *while in the other all would be peaceful and still.* **The birds singing in the trees,** *the ducks, geese, and hens cackling in the farmyard, the bleating of the* **sheep and lambs,** *and the lowing of the* **oxen** *in the meadows, would be almost the only sounds to break the stillness all round.*

Summary of the Lesson

1. A town consists of roads and streets packed close with houses and shops. It has its market-places, as well as schools, churches, and other large buildings.

2. Many people live in the town, because their work is in the town.

3. Some towns contain large factories and workshops, where hundreds of people are busy all day long.

4. A village consists of a few houses and shops, with a church and a school.

5. Only a few people live in the village, because there are no great factories or workshops there. The work to be done in the fields does not require many people.

Lesson XVII

A RIDE IN THE TRAIN

Provide for illustration a good picture of the locomotive with one or two carriages attached. The modelling tray, with models of hills and valley, toy train, tunnel, etc., will also be required. Brown's Picture of the same will be useful for recapitulation.

I. Introduction

The object of this lesson is to give these young children—and more especially the children of the towns—their first simple

notions of the configuration of the ground; and an imaginary railway journey, it is thought, will accomplish the purpose better than anything else.

The recent chat about tram-cars and omnibuses will form the best and most natural introduction to the new lesson.

Commence by referring to them now, and point out that, although they are very useful for carrying people from one part of the town to another, they would not do for long journeys.

When people want to take a long journey how do they go? They go in a **train.**

Hands up, all those who have seen a train.

That's right. Now I want you to tell me all you can about it.

Elicit, step by step (assisting of course where necessary), that the train is made up of a **number of carriages**, *each of them bigger than a tram-car; that they are* **joined together** *by strong iron chains; that when they are linked together in this way, they form a long line, or train of carriages, and it is that which gives the name; that instead of horses they have* **a great engine** *in front which pulls them along; that they do not run along the roads of the town like the tram-cars, omnibus, carts and other vehicles, but on* **roads of their own**; *that these roads, like the tram-ways in the town, have* **iron rails laid down on them** *for the trains to run along, and that this is why we call them* **railroads** *or* **railways**; *that they go very fast*—**much faster than a horse** *could run; and that they do not stop, as the tram-cars do, for people to get in and out as they wish, but have* **stopping-places of their own** *along the line, which we call the* **railway stations.**

II. The Engine

1. *Show a good picture of a locomotive, and one or two carriages attached to it.*

Look at the engine in front of the train. We sometimes call it the great iron horse.

Can you tell me why? **Because it draws the train along the railroad,** just as a horse draws other carriages along the roads and streets of the town.

What must we do for the horse if we want him to work for us? We must **feed him.**

Tell that this great iron horse **must be fed too.** *Call attention to the big truck next to the engine,* **piled up with coals,** *and explain that* **this is the food which the great iron giant devours.** *He could not work without it.*

Point out the furnace of the engine, where one of the men is busy shovelling in coal.

Notice how bright and red the fire looks. Tell that if this were a real engine instead of a picture, we should **hear the furnace roar,** *every time a fresh shovelful of coal was thrown in.*

2. What can the engine want with all this coal?

Point to the clouds of vapour flying off from the funnel of the engine. Explain that the inside part of the engine is **a boiler** *which is kept full of water, and the fire is wanted* **to boil this water,** *and* **change it into steam,** *just as we changed the water in the flask over the lamp.*

It is this **steam which makes the engine move,** and pull the train along.

It takes two strong horses to pull the tram-car along. Think how powerful this great engine must be—it does more work than a great many horses could do. **It gets all its power from the steam** of the water which is boiled in its boiler.

3. *Lead the children to describe the strange scream or cry which the horse sometimes makes. Explain that horses are said to* **neigh,** *when they make this noise.*

Our great iron horse—the railway engine—**makes a shrill, screaming noise** too, sometimes.

Can you tell me what it is like? It is like **a very loud, shrill whistle.**

Explain that this whistle is caused by the engine-driver

letting off some of the steam. **As the steam escapes, it makes that shrill, whistling sound.** *The driver does this to let the people know that the train is ready to start out of the station.*

III. The Journey

1. Let us suppose that we are going for a ride into the country in this train; that the driver has given his whistle; and that we are in our carriage with the door shut fast. The engine gives a **puff, puff, puff,** and we are off.

Now will come the opportunity for the teacher to describe the imaginary journey out of the town according to the particular locality. In one case the train will run on arches for a considerable distance, and the children may be led to form a graphic picture of the scene, as they look down upon it from the carriage windows. In another it may run along the level ground or through a cutting, and the houses will be seen above them on either side and so on.

2. *In any case it should be noted that, as the journey proceeds, the houses, instead of being closely packed, as they are near the station, are scattered more and more thinly, till at length* **the last house is passed,** *and there is* **nothing but the open country** *all round.*

Picture the train rushing on now, leaving a cloud of vapour behind it, and lead the children (those who have been in a train) to tell that it goes so fast and so smoothly that **the trees and hedges,** *and* **the tall posts** *by the side of the line,* **seem to be moving quite as quickly in the opposite direction.**

3. *Proceed to describe the nature of the imaginary country through which the train is passing.*

In one place the land is **flat and level everywhere,** *like the school playground, and the level green fields stretch away on all sides, as far as the eye can reach.*

Uncover the model now, and illustrate country of this kind, with the toy train moving along over the level ground.

We call **flat, level land like this a plain.** Some plains stretch so far that it would take a train several days to cross one of them.

4. *Continue the description with the aid of the model.*

The train still goes on, but we notice, as we look out of the windows, that **the land on either side is rising little by little,** till at last it is **much higher than the train.** We cannot see the green fields now; we seem to be shut in by a high bank on either side of us.

Presently we hear the shrill whistle of the engine, and then all of a sudden **we find ourselves in darkness.** We can hear that the train is still rushing on, **for it makes more rattle, more noise, than ever now.**

Little boys and girls creep up close to mother in the darkness, wondering what is the matter, and half afraid that something dreadful is going to happen.

But it does not last long. In two or three minutes the light begins to come again, the train makes less noise, and we find ourselves in the open air once more.

What has happened? Let me show you.

5. *Illustrate all this on the model. Move the toy train on, and show where the land gradually begins to rise.* **It is not level** *like the part through which the train has passed. It continues* **to rise higher and higher.**

Point out that, where the train runs between those high banks a level road **has been cut through this rising ground.** We call this part of the railroad **a cutting.**

6. *Send the train on now through the dark hole at the end of the cutting, and let the children see it come out at the other side.*

Explain that this long hole is like the dark place through which the actual train passes. We call it **a tunnel.**

When we are in a real tunnel, we are **in a hole like**

this cut through the earth, and we have **a great mass of earth, hundreds and hundreds of feet high above us.**

Explain that it is easier for a train to travel along a level road than up a slope. That is why tunnels are cut through the earth, when it rises up into a great mass like this.

Land which rises up in a high mass many **hundreds of feet above the level country all round is called a hill.**

7. *Let the children point out the other hill in the model.*

Notice that between the sloping sides of these two hills there is a **low, hollow place**—*lower than the plain. The sides of both hills slope down and meet at the bottom of it.*

Point out that the train can only get across this low place **by means of a bridge.**

The **low land** that lies **between two hills** is called **a valley.**

Summary of the Lesson

1. A plain is flat, level land.
2. A hill is a mass of land which rises many hundreds of feet above the level country all round.
3. A valley is a low, hollow place between two hills.
4. A small valley is called a vale or a dale.

Lesson XVIII

A SPRING

The teacher will require a rough tray, or board, with clay, sand, and gravel, and a common watering-pot, with a very fine rose-nozzle. Brown's Picture of a Spring should also be provided.

I. Recapitulation

Our last lesson told us something about the ground we walk on, and we know now that it is not all like the roads and streets of the town.

In one place it is **flat and level like our playground.**

What name do we give to this flat land? **We call it a plain.**

In another place, instead of being level, **it rises higher and higher,** so that we should find it hard work to climb to the top. When we get to the top we find ourselves **on a great mass of land, higher than the highest church steeple**—hundreds of feet above the level country all round.

What do we call a mass of high land like this? We call it **a hill.**

Then what do you understand by a hill? **A hill is a part of the land which rises very high above the flat land all round it.**

You remember too we spoke about some very low land—**lower than the plain.** Where do we find low land of this kind? Between two hills.

What do we call it? We call it **a valley.**

How is the valley formed? By the sloping sides of the two hills, which meet at the bottom. **A valley is the low land between two hills.**

II. What the Ground is made of

1. As we now know something about the surface of the ground, let us next try to find out what the ground itself is, and what it is made of.

You have all seen the ground dug up in the garden. What is this ground like? It is soft black soil in which the plants grow.

Tell that, not only the garden ground, but the green fields —**the plains, valleys,** *and* **hillsides**—*are all* **made of soil** *like this. Without it nothing would grow. There would be no green grass, no trees, no plants anywhere, because the plants feed on this soil.*

This black soil is only **the top part of the ground.**

2. Can you tell me some of the things which men find, when they dig down into the earth below this soil? **Sand, gravel, clay, chalk, slate.**

No doubt most of the children have seen digging going on in different places, and they know that the men throw up to the top whatever they dig out of the hole.

Lead them to tell that they have never seen a heap of earth, sand, gravel, chalk, and clay all mixed up together at the side of the hole. In one place they may have seen a heap of sand, in another a heap of clay, and in another again they might see nothing but chalk dug out.

Explain the reason for this.

3. These things all **lie in beds or layers one under the other.** The men must dig down through one bed, before they can reach another.

Illustrate this by means of a sketch on the black-board.

Tell that in one place **the sand and gravel** *may be nearest the top, in another* **the chalk,** *and in another* **the clay**; *but they are* **always in beds or layers** *one under the other.*

III. More about the Rain

1. We must leave all this for awhile, as I want you now to think about our old lesson on the rain, and what becomes of it.

Why does the rain fall from the clouds at all? Because, when the clouds get cold, the water-vapour changes

into drops of water. **Water is heavier than air,** and the air cannot hold it up. It must fall in rain.

Point out that the tops of the hills are so high that **they touch the clouds,** *and* **the cold earth makes the**

clouds cold. *There is always* **more rain in the hilly parts** *of the country than in flat land.*

2. *Picture the rain falling on the hills, and lead the children to tell (as far as they can) what becomes of it.*

(*a*) Some of it changes back into **water-vapour,** is sucked up by the air, and rises to form new clouds

(*b*) Some of it **flows away** down the hill-sides,

as we sometimes see it flowing down the gutters of the streets.

(*c*) Some of it **soaks into the ground,** because the ground is porous.

3. *Call attention once more to the sketch on the black-board, and lead the children to trace the rain, as it sinks through the beds of sand, gravel, and chalk, and reaches the clay bed.*

Why does it sink through these beds? Because they are **porous.**

What happens when the water reaches the clay? It cannot pass through the clay, **because clay is not porous.**

Explain that there are **other porous beds** *in the earth besides those we have named, and other beds besides clay which are* **not porous.** *But whatever the beds may consist of, it is always the same in the end.* **The rain soaks through the porous layers one by one,** *till it comes to something which, like the clay, is not porous, and* **it cannot pass through that.**

4. It collects there on top of the clay, or whatever it may be, till **there is not room enough to hold it all;** and at last bursts through **between the clay bed and the porous bed above,** and forces its way out somewhere through the side of the hill.

We see the water there bubbling up out of the ground, **and we call it a spring.**

5. *Uncover the tray now, and call attention to the basin like hollow that has been made with the clay. Fill up the hollow with coarse gravel first, and sand above it, to the level of the clay-rim, and then pour water on it from the watering-pot, calling upon the children to observe what happens.*

What becomes of the water? It **soaks into the sand.**

Why? Because **the sand is porous.**

How far will it soak through? Till it comes to the clay.

Where is all the water now which we have been pouring on the sand? It is collecting on the top of the clay; **it cannot pass through the clay.**

6. *Continue to add water from the can, till some of it begins to ooze out from the edge of the clay-basin in view of the class.*

This explains what becomes of all the rain that soaks into the earth.

It rises again to the surface in the form of a bubbling spring.

Show and describe, in connection with this, the picture of the spring.

Summary of the Lesson

1. The earth on which we walk is made up of sand, rock, gravel, chalk, slate, clay, and other things.
2. These things all lie in beds or layers, one beneath the other.
3. The rain soaks through some of them, such as chalk, sand, gravel, because they are porous; but it cannot soak through clay, because clay is not porous.
4. When the water reaches the clay it collects there, till at last it finds a place where it can force its way out. It then bubbles up out of the ground and forms a spring.

Lesson XIX

A RIVER

The teacher should be provided with Brown's Pictures of the River and the Spring, and the model of a river and its feeders.

I. Introduction

In a country like ours there are probably very few children who have not seen a river of some sort, but each locality gives its

own colouring to the picture, and so the word "river" calls up different associations in the minds of different children.

It should be the teacher's first aim to interest the children in the particular scene with which they are already familiar, and after eliciting from them all they can tell about that, it will be an easy matter to rouse their curiosity as to **what this river is, why it is always flowing on, where it comes from, why it winds about,** *and* **what becomes of it** *after it flows past their town.*

II. Rivers are Running Streams

1. If we go out after a heavy shower of rain, we find the **gutters by the side of the roadway** full of water, and we often see **puddles of water** in the road itself.

What becomes of the water in the gutter? It **flows away** to the drains.

Why does it flow? **Because the gutter slopes down,** and **water always tries to get as low as possible.**

Ask the children to notice for themselves, the next time it rains, that the water remains in the puddles long after the gutters have become dry. It does not flow away as the water of the gutter does: **it stands in the little hollows** *where it fell.*

They can easily prove this by dropping a piece of cork, stick, or paper into each. The **running stream** *of the gutter* **will carry these things along** *as it flows; but those that are put into the puddle do not move,* **because the water itself does not move.**

2. *Tell that, if we throw a stick into the river and watch it, we shall see it float away, because* **the river is a running stream,** *like the water of the gutter. It carries the stick along, as it flows; and* **it always flows in one direction, because water can only flow downwards.**

If we throw the same stick into a pond, it will remain floating where we throw it, because **the water of the pond is**

still or standing water. *It does not flow along as the water of the river does.*

III. How Rivers are Made

1. The stick would show us which way the river flows. But how could we find out where it begins, and where all this water comes from? We should have to walk back by the side of the stream in the other direction.

Explain that this would not be an easy task. It would take us many days, perhaps weeks, of hard walking to get to the place where the river begins.

Show the picture of the river. Trace the stream back as far as it can be seen. Notice that the farther we go **the narrower it becomes.** *It seems to come from those hills in the distance.*

2. *Tell that if we want to get to the* **very beginning of the river,** *we must climb one of those hills, and then we shall find, somewhere on the hillside, a place where* **water is bubbling up out of the ground.**

That of course will be quite hint enough for the children. All will be eager to tell that this water which bubbles up is called **a spring,** *and that springs are formed by the rain which soaks into the earth.*

The rain makes the spring, and **the spring makes the river. Rivers** therefore are **made by the rain** that falls from the clouds.

3. *Show the picture of the spring again now.*

Tell that this is **the beginning of the river.** *We call it* **the source of the river**; *and we say* **the river rises here,** *because the water first bubbles up out of the ground here, in the form of a spring.*

Tell too that, at the source, the river is **a tiny stream**; *we could easily* **step across it.** *We call this little stream* **a brook.**

Which way must it flow? Will it flow fast or slowly? Why?

4. *Illustrate by pouring a little water on a slate. Show that when the slate is level the water is at rest; when it is tilted ever so slightly it begins to flow slowly down; and when it is tilted more it flows rapidly.*

Apply this to the stream as it makes its way down the hill-side, and deduce that **the flow of the water** *down the slope of the hill must be* **very rapid everywhere.**

Picture it as it **dashes onwards** *and* **leaps from ledge to ledge.** *Compare it with the streams of water, which are seen* **rushing down a sloping roadway after a heavy rain.**

5. *Lead the children to describe the state of the road itself after the rain is all over. The rushing water makes those* **ruts and hollows in the road,** *because* **it washes away all the soft earth** *and mud, and leaves only the stones.*

The streams which flow down the hillside are **like these streams in the road.** They **wash away all the soft earth and mud,** and **dash along over the stones.**

How long will the water continue to flow down the hill? Till it reaches the **lowest ground** at the foot of the hill.

What do we call this low land at the foot of the hills? We call it **a valley.**

Explain that all rivers, after they leave the hills, **run along through the valleys,** *because the water is always trying to get to the lowest point it can find.*

Would you expect the water to flow faster or slower in the valleys? Why?

IV. How Rivers Grow

1. *Tell that, if we went for a ramble over those hills where the river rises, we should be sure to find* **other springs,** *exactly like the first, bubbling up out of the earth.*

The water from those springs **must also flow down the sides of the hills;** it cannot stand in a heap there.

Remind the children too that, some of the rain which falls on the hills does not soak into the earth, and go to form springs, but at once **begins to flow away.** *This too must flow down into the valleys* **in little streams.**

2. Let me show you next what becomes of all these little streams.

Uncover the model now. Trace the **main stream** *back towards its* **source** *among the hills. Point out the numerous* **smaller streams** *on both sides of it*—**all flowing down to join it.**

These little streams bring their water down to the big river, and every one that joins it **makes it bigger still.** We call them **the feeders** of the river, and sometimes **the tributaries.**

Explain the meaning of this term.

Point out that each of these streams—the big river and the feeders—**flows along the bottom of its own little valley,** *which is lower than the ground on either side.*

This we call **the bed of the stream—the groove or channel in which it flows.**

V. What Becomes of the River

Tell briefly that the river does not stop after leaving us—it flows on and on, getting **bigger, broader,** *and* **deeper,** *as more and more streams flow into it, and at last* **it pours all its water into the great wide sea.**

Tell that this part of the river, **where it joins the sea,** *is called* **its mouth.**

Picture the great expanse of water with the ships coming and going. The sailors on the ships often lose sight of land altogether for weeks at a time. There is **nothing but water to be seen** *all round them. This water is the sea.*

Summary of the Lesson

1. A river is a stream of water flowing over the land.

2. Rivers are formed from the rain. The rain makes the spring: the spring makes the river.

3. The beginning of a river is called its source.

4. The river flows because (like the water in the gutter) it is always trying to get as low as it can.

5. The little streams which flow into the river are called its tributaries or feeders.

6. The rivers flow on and on, till at last they pour their water into the sea.

LESSONS ON THE CARDINAL POINTS

Lesson XX

ANOTHER LESSON FROM THE SUN

I. The Boy's Shadow

1. *If the advice given at the close of Lesson V. has been carefully followed out, the children ought now to be quite familiar with the idea of an arch in the sky, along which the sun* **seems to make its journey day by day.**

They will have seen that every day at twelve o'clock **the sun shines exactly over the same fixed object,** *and by noting its position from time to time both before and after noon, they will have no difficulty in tracing the supposed arch along the sky. In other words, the position of the sun at* **sunrise, noon,** *and* **sunset,** *ought now to be clearly understood from actual observation.*

2. *Making this the starting-point for what is to follow, the teacher would do well to seize the first fitting opportunity of a fine sunny noon-day, and take the class into the playground for a few minutes' preliminary observation preparatory to the next lesson.*

Commence by first calling the attention of the children to the

sun in its usual position, **exactly over the well-known object,** *where they have noticed it so often before.*

Elicit that we see the sun there now, **because it is twelve o'clock, or noon;** *and that at noon the sun is* **half-way across the sky**—*it has finished the first half of its day's journey.*

Let them trace across the sky the course which the sun seems to take **between sunrise and sunset.**

3. *Call upon them to point towards that part of the arch*

where the sun rises, *and elicit that this is called the east.* **The sun rises in the east.**

Notice that the other end of the arch, where the sun sets, is **exactly opposite the east.** *We call it* **the west.**

Now place one of the children with his back to the sun, and his arms stretched out right and left.

Elicit in the first place that in this position s always in *stretched arms are pointing to* **the two opposi** **the supposed arch**—*that his right hand is poi*ur backs **east,** *and his left hand to the* **west.** north,

4. *Call attention next to* **the shadow which he throws on the ground.**

Trace it on the ground with a piece of chalk as he stands there, and show that it forms **a sort of cross** *on the ground —the four parts of the cross* **pointing four different ways.**

Lead the children to tell that one of them points **in the direction of the sun,** *another in* **exactly the opposite direction;** *another* **to the east,** *and another* **to the west.**

This will be sufficient in the way of out-door observation. The teacher will pick up the thread when the children reassemble in class.

II. North and South

1. *Commence the class-work by referring at once to the shadow-cross on the ground outside. Be careful to elicit that* **the four arms** *of the cross* **pointed four different ways**—*one* **towards the east,** *another* **towards the west,** *another* **towards the sun,** *and another* **away from the sun** *in the opposite direction.*

Call upon the children now to point out the direction in which they always look for the sun at noon.

2. Suppose we draw a chalk-line on the floor pointing in that direction.

Which end of this line points in the direction of the sun at noon?

Then in what direction must the other end point? **Away from the sun.**

Now, before we go any farther, I want you to learn two new names. Whenever we see the sun at twelve o'clock, we say **it is in the south;** the point **exactly opposite the south is the north.**

sun in its , *a child to the front again, and let him stand* **object,** *wh e of the chalk-line in the same position, and with* *Elicit t utstretched as before.*

o'clock What direction is the boy looking? He is looking **towards the north.**

What has he behind him then? **The south.**

Suppose I write **N.** for **north** and **S.** for **south** at the two ends of this line on the floor.

Remember, these points never alter, because **the sun is always in the south at twelve o'clock,** and the north is opposite the south.

4. *Remind the class that the other child stood in exactly the same position in the playground, with his back to the sun and facing the north, and lead them to tell that in each case the boy's right hand pointed to the east and his left towards the west.*

Complete the cross on the floor now, and place the letters **E.** *and* **W.** *at the ends of the cross-line to indicate* **east** *and* **west.**

Tell that these four points, North, East, South, West, are called **the four cardinal points,** *which means* **the four chief points,** *or* **the four principal points.**

Lead the children to tell that the east is the place where the sun rises in the morning; the south shows us the position of the sun at noon; and the west is the place where the sun sets in the evening.

When is the sun in the north then?

Explain that **we never see the sun in the north.** *If there are any north windows in the schoolroom they are probably without blinds. Point them out, and tell why blinds are not needed.* **The sun never shines in through those windows.**

5. You can all now find North, South, East, and West for yourselves in your own streets, or in the fields, or wherever you may happen to be at mid-day.

You have only to remember that the sun is always in the south at noon, and the rest is easy.

If at twelve o'clock in the day **we turn our backs towards the sun,** we know we are **facing the north,** and we have the **east on our right hand** and **the west on our left.**

III. The Use of Knowing these Points

1. *Proceed next to exercise the children in walking in various directions (north, south, east, and west) across the room. Then reverse the order of things and ask—*

In what direction am I walking now? What direction am I coming from? and so on.

After this it would be an easy step to deal in a similar way with a few of the streets in the near neighbourhood of the school. This would gradually familiarise the children with a fact which too often is not made sufficiently clear by young teachers—namely, that these directions, although pointed out by the sun, have to do **not with the sky,** *but with the earth on which we live.* **They show us the way from one place to another.**

2. *Remind the children that we ourselves, when we are going from one place to another, do not need the help of these points, because there are good roads everywhere, and they tell us which way to go. Then picture the great wide sea which we spoke about in our last lesson.*

The sailors in their ships are often **far away out of sight of land.** *There are* **no roads on the sea** *to guide them. They are very glad of the sun's help. They have only to remember where the sun is at twelve o'clock in the day, and they can easily find all the other points, and then they know which way to go.*

Summary of the Lesson

1. North, East, South, and West are called the Four Cardinal Points.

2. The sun rises in the east. It is always in the south at noon. It sets in the west.

3. We never see the sun in the north.

4. When we turn our backs to the sun at noon, we have the north in front of us, the east on our right hand, and the west on our left.

5. These four points show us the way from one place to another.

Lesson XXI

THE SUN-DIAL

The teacher will require the spike and disc for observation in the playground, and an extemporised model of the sun-dial, which could easily be made for the occasion.

I. Noon-Day Shadows

1. *This lesson, like all of a similar class, depends for its full development upon actual observation. It would be best given out of doors, either in the playground or during a ramble in the fields, where such a thing is possible.*

The **spike and disc** *suggested in one of the earlier lessons for observing the length of shadows at noon throughout the year, should of course be made* **the starting-point in this one.** *But needless to say, if the lesson is given during an out-door ramble,* **a walking-stick set upright in the ground** *will serve all the purposes of the spike and disc.*

2. *When the lesson itself must be given in the school-room, the teacher should seize the opportunity of taking the class into the playground* **at the mid-day dismissal,** *so that they may observe for themselves the spike, and* **the shadow which it throws on the ground.**

It would be well there and then to make **a chalk-line on the ground,** *to show the* **length** *and the* **direction of the shadow.**

3. *One or two questions will suffice before dismissing the children, thus:—*

In what part of the sky is the sun now? It is **in the south.**

Then, as it shines on the spike, in what direction must the shadow point? The shadow must **point towards the north.**

Right. We will put the letter N at the end of the chalk-line to show that.

In connection with this it should be clearly understood by the children that not only the spike and the walking-stick, but **every object on which the sun shines** *at 12 o'clock, casts its shadow towards the north.*

II. The Shadow moves

1. *When the time for re-assembling comes round, lead the class once more to the same spot, and let them observe for themselves the change that has taken place. They will readily tell that:—*

The shadow cast by the spike **does not now point along the chalk-line** in the direction of north. It points some distance **to the right of the letter N.**

2. *Mark out this shadow-line on the ground, as before, with chalk. That done, set one of the class to measure this line, and compare it with the one which points north.*

What can you tell me after measuring this line? **It is longer** than the shadow which the sun made at 12 o'clock.

Why is that? Because **the sun is lower in the sky** now than it was at noon. When the sun is high **it casts short shadows,** when it is low down **the shadows are long.**

3. *Play-time, about the middle of the afternoon, and closing-time, when school is over for the day, will afford two further opportunities for useful observation.*

The teacher should carefully mark out with chalk on the ground, as before, **the length** *and* **direction** *of each shadow cast. Measure the chalk-lines, and lead the children to tell that:—*

(*a*) Each one is **longer than the last;**

(*b*) The shadow is, little by little, **moving from the north towards the east.**

4. *Before dismissing the children be careful to explain that, as the rest of the day wears on, and the sun sinks lower and lower towards its setting-place in the west,* **the shadow will continue to move towards the east,** *gradually getting longer and longer.*

It would be well, if possible, to induce some of the children, who live near the school, to observe this for themselves. Let them chalk out the length and direction of the shadows from time to time, as they have seen the teacher do, and then they can report to the class the next day.

What will become of the shadow when the sun sets?

5. *At the assembling-time next morning take the class once more to the spot, and point out the direction of the shadow now.*

Observe that it is on the other side of the letter N now. It points **between the north and the west,** but it is nearer the west than the north. It is **a long shadow.**

6. *Lead the children themselves to tell that:—*

(*a*) In the morning **the sun rises in the east;**

(*b*) It is now **moving from the east towards the south,** which it will reach at exactly 12 o'clock;

(*c*) All through the forenoon it will be **mounting higher and higher in the sky.**

7. *Endeavour to elicit from this that:—*

(*a*) As the sun approaches nearer and nearer the south, it will cast the shadow of the spike **nearer and nearer towards the north;**

(*b*) As it gets higher and higher in the sky, **the shadow will become shorter and shorter.**

Of course all this should be verified once or twice during the morning by actual observation as usual.

III. A Sun-Clock

1. *The children will now be in a position to intelligently follow the description of the sun-dial itself.*

With a little ingenuity the teacher could easily make a rough and ready model of the instrument, sufficient to answer all purposes.

Show **the dial** *itself, and lead the children to tell that it looks* **something like a clock-face.**

2. *Explain that* it is really **a sort of clock-face,** *and that* **those figures** round the circle, at equal distances apart, **point out the hours of the day,** just as the figures on an actual clock do. It is **a sun-clock.** It has **no works** inside as real clocks have. **The sun makes it work.**

3. Look at it again. Do you see any difference between this funny clock-face and the face of a real clock? The figures are not placed all round the circle. The figures for some of the hours seem to be left out.

Exactly. Let us see why this is. But first of all we will find out how this sun-clock works.

4. *Fix the spike now in the centre of the dial and proceed:—*

What would happen if we stood our sun-clock outside in the playground?

The sun would cast **a shadow of the spike on the face, or dial.**

In what direction does the sun cast its shadows at 12 o'clock? Exactly **north.**

Why? Because the sun itself is **always in the south at 12 o'clock.**

5. Then all we have to do is to fix our sun-clock, or sun-dial as it is called, in a sunny part of the playground, **with the figure XII. pointing to the north.**

If that is done, we shall find when we leave school at 12 o'clock that the spike is throwing **a shadow exactly across the figure XII.** This sun-clock will **tell us the exact time.**

When we return to school in the afternoon we shall find the shadow **between the figures I. and II.**; when we leave school for the day, it will be **between the figures IV. and V.**, and so on.

6. We can tell the time at any part of the day **so long as the sun is shining.**

But what will happen on dark days when we do not see the sun? The clock will not work then, **because the spike cannot throw any shadow without the sun.**

Now can you tell me why there are no figures on part of the circle? The part where there are no figures **stands for the night, when the sun is not shining.**

7. *Explain that* the figures marked on the dial **begin with 3 o'clock in the morning, and end at 9 o'clock at night**; *and elicit from the class that* **in the middle of summer we get very long days,** for the sun then rises about 3 o'clock in the morning, and does not set till between 8 and 9 o'clock in the evening.

This sun-clock would **tell the exact time** all through those long summer days.

8. *Tell that sun-dials (or sun-clocks) made of stone are sometimes set up* **in parks or gardens**[1] *now* **for ornament.** *Then explain that long, long ago,* **before people learned to make real clocks and watches,** *the sun-dial was almost* **the only way they had of telling the time.**

How strange it must have been during the dark, sunless days of winter, and at night, for of course their sun-clock was then useless.

[1] In an actual sun-dial, the part which answers to our upright spike is known as the rod or style, and the dial itself is not always placed in the horizontal position. It is sometimes built into a wall, *i.e.* in a vertical plane. These, however, are details with which young children need not be troubled.

Summary of the Lesson

1. At noon the shadows all point towards the north.
2. During the afternoon the shadows move round little by little towards the east.
3. We lose the shadows altogether when the sun sets.
4. In the morning, and during the forenoon, the shadows gradually move round from the west towards the north.
5 The sun-dial is a sun-clock. When the sun is shining we can tell the time by noticing the shadow which the spike casts on the face or dial.

Lesson XXII

A LESSON FROM THE STARS

I. Introduction

1. How many of you have tried to find the north, south, east, and west for yourselves since our last lesson?

That's right. You shall now tell us how you did it.

Lead the children step by step to recapitulate the main points of the preceding lesson, and so to tell that at noonday, with the sun in the south behind them, they have the north facing them, the east on their right hand, and the west on their left.

Proceed next to show that it would be quite as easy to find these four points in the evening, **when the sun is setting,** *or in the early morning,* **when it is rising.**

2. *Ask for the position of the sun at these times, and little by little deduce the rest, so as to prove that* **the right hand stretched out towards the rising sun,** *or* **the left hand towards the setting sun** *would give us all four points exactly as we have already found them. We should in each case have the south at our back, and the north facing us as before.*

3. *In this way it would be made quite clear to the children that, it is only necessary* **to fix upon one of these three points**—*east, south, or west—to find all four.*

Why not find the north first, and learn the others from

that? We cannot do this **because the sun is never in the north.**[1]

I see you know how to find these four points with the help of the sun.

Perhaps you would now like to learn how to find them at night when the sun is not shining.

II. Charles's Wain

1. What do we see shining in the sky at night, after the sun has set? The **moon and stars.**

What becomes of the stars all day long? **They are always there** day and night.

Then why don't they shine in the daytime? They shine then **just as they do at night.**

But we do not see them in the daytime. How is that? Because the light which they give is very weak and pale; **it cannot shine through the bright light of the sun.**

2. *Tell that the stars at night can help us to find the north, south, east, and west, as easily as we find them with the sun in the daytime.*

Mark on the black-board the position of the seven stars, and proceed in some such way as this:—

To-night, if there is a clear, starry sky, I want you to search it all over, till you find **seven large, bright stars** near each other in this position.

3. People have given these seven stars very curious names. Some call them **the Plough,** and they say that **the four stars** form the **plough itself,** and **the three others** in a line make **the handle.**

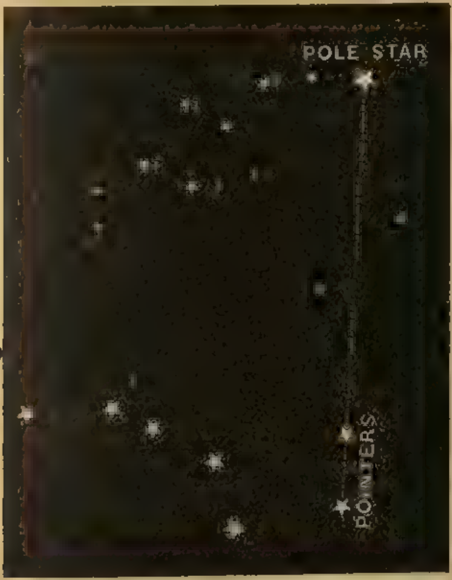
Others call them **the Waggon and Horses,** or **Charles's Wain.** The word **wain** means a **waggon.**

Others again call them **the Great Bear with a long**

[1] We are now on the level with these young children. It will be quite soon enough to enlarge upon all this when the shape and motions of the earth have been taught.

tail; but I don't think you will see much likeness in them either to a plough, a waggon, or a bear.

4. I don't mind which of these names you give them,



if you will try to remember the sort of figure which the seven of them make.

I have given each of you a piece of paper and a pencil. You may now draw them, just as I have done on the black-board, for I want you to make use of your drawing this evening when the stars are shining.

After allowing time for the children to do this, continue as follows:—

5. Now, with your drawing in your hand, I want you to search all over the sky this evening till you find these seven stars.

There are so many stars in the sky that, you will not find it an easy task to pick out these at first, so I will help you.

It will be best to go to the place, where you watched the sun at twelve o'clock. You remember the direction in which you found the sun then. **That is the south.** If you turn your back to this as you did then, and look up at the sky, you will soon be able to find the seven stars; for they will be exactly like those you have drawn on your paper.

You will find them **in the part of the sky which faces you,** as you stand with your back to the south.

All through the year, summer and winter, they are in that part of the sky; but in the winter you will find them **much lower down**, than they are in the summer.

6. *Be careful to explain that, when we have once found these seven stars, and noted their position in the sky, it is not necessary for us to go to any particular place. We can find them wherever we may be.*

It will not be so hard to find them a second time, because no other set of stars make the same sort of figure in the sky. It is really very easy to pick them out, although there are so many all round them.

III. The Pointers

1. But your work will not be done when you have found Charles's Wain.

Let us have another look at the black-board.

Rule a line with a ruler **through the two end stars of the waggon,** *and continue it upwards for* **about seven times the distance,** *letting the children do the same on their papers.*

Now at the end of this line I want you to put **a very large star.** This is the star we want to find.

It is called **the North Star,** and sometimes **the Pole Star.**

2. When, this evening, you have found the seven stars, run your eye through those two end ones, up and up in a straight line, till you see another star **much larger and brighter than any of those near it.** That will be the star you want—**the North Star.**

The two stars through which we run the line upwards are called **the Pointers.** Can you tell me why? Because **they point out the North Star,** which is the one we want to find.

3. *Explain that this North Star stands* **immediately over the north part of the world,** *and that when we face it and walk towards it,* **we are walking towards the north,** *and must therefore have* **the south behind us,** *just as we had at twelve o'clock in the day.*

How shall we find the east and west then?

IV. The Use of Knowing this

Remind the children once more of the sailors in their ships on the great wide sea.

The sun is their guide in the daytime; but what are they to do after the sun has set?

The ship cannot stand still all night; it must go on just the same as in the day.

When they can no longer see the sun, **the sailors look for Charles's Wain**; that points out to them **the North Star,** and then they know exactly which way to go.

Summary of the Lesson

1. The Pole Star helps us to find the four Cardinal Points at night when the sun is not shining.
2. To find the Pole Star we must look for Charles's Wain.

3. Charles's Wain is formed by seven large bright stars, which are sometimes called the Waggon and Horses.

4. The two end stars are called the Pointers, because they point out the North Star.

Lesson XXIII

THE VANE

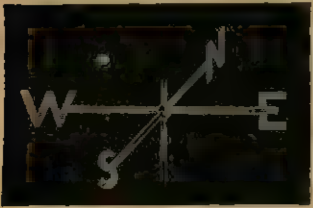
Have in readiness the model of the vane as described in the lesson. Provide also a sheet of stiff drawing-paper and a pair of scissors for the purpose of extemporising a similar contrivance for experiment.

I. The Four Arms

1. *Produce the stand of the toy weather-cock, showing the four arms without the indicator. Notice that these four arms point in four different directions, and that they have the letters N. E. S. W. at their extremities.*

Elicit the meaning of this, and then let one of the children place it in its proper position on the table, with the north arm **pointing to the north part of the room.**

Point out that if this could be fixed up somewhere in the room, we should always know the north, south, east, and west end of the room **without thinking about it;** *and then ask the class whether they have ever seen anything like this before, and if so, where they have seen it.*



2. *There is probably* **a vane over the bell on the roof of the school,** *and if not, the children will be sure to have seen one on some of the public buildings in the place.*

Say nothing of the name at present. We are only concerned now with those **four arms,** *fixed high up on the roof of the building, and* **pointing in four different directions,** *N. E. S. W.*

Elicit from the class that those four letters at the ends of the four arms point out to us at once, whenever we look at them, the north, east, south, and west, **without giving us the trouble to find out through the sun or the stars.**

II. The Part that Moves

1. Now I want you to look at this model on the table, and think about those you have seen on the tops of tall buildings.

Have you found out any difference between those and this one? Yes; there ought to be something on the top of the spike.

Oh! I see. (*Place the arrow in its proper position.*) Is this anything like it?

The arrow will probably satisfy some of them, but to others the figure of the bird may be a more familiar sight. Remove the arrow and put the bird in its place. Explain that sometimes one and sometimes the other is used. It does not matter which it is.

We call the four arms with the figure (whatever it may be) above them **a vane.** Perhaps some of you have watched the arrow or the bird on some vane.

Can you tell me anything about it? It is not fixed in one position like the four arms. **It moves round. It sometimes points one way, and sometimes another.**

Let us see whether our arrow is made to move round

too. Yes; you see it moves round easily with the slightest touch.

Replace the arrow with the bird, and show that **this moves round too,** *as easily as the arrow.*

Now as the four arms with the letters N. E. S. W. at the ends of them are fixed, so that they always point in the same direction, why should the bird and the arrow move?' Let us try to find out.

III. Why it Moves

1. *Call one of the children to the front, and instruct him to blow as hard as he can against the bird. Observe that* **the bird at once spins round,** *and* **looks him straight in the face.**

Call upon several others to repeat the blowing from different sides of the table, and let the class see that the result is always the same. The bird each time spins round, **till its head faces the child who is blowing.**

The same experiment, of course, should be repeated with the arrow, and the children will see in this case that the point of the arrow, like the head of the bird, **always swings round towards the face of the person who is blowing.**

2. Have you been able to find out yet why the bird on the top of the school moves round? It must be **the wind that blows it round,** just as our breath blows this one round.

Quite right. But why do the head of the bird and the point of the arrow always face the wind? This is a puzzle which we must find out.

3. *Cut out in stiff drawing-paper a figure of a bird, exactly*

like the one that has been used. Then make a couple of slits in it about the middle, and fix it up on the spike.

Show that this moves round readily enough when we blow against it, **but it does not each time face the direction from which the wind comes.**

Remove it now, and make two other slits, as indicated in the sketch, **much nearer the head than the tail of the bird.** *Show that when the spike is passed through these two slits, the bird not only moves round, but* **always faces the direction from which the wind is coming.** *It cannot be moved while the wind comes from that quarter.*

Point out now that the arrow and the bird on an actual vane are both fixed to the spike **much nearer one end than the other.**

4. But we have not yet found out the puzzle. We still want to know why it is that the bird and the arrow always face the wind.

Lead the children to compare the big, broad tail-end of the bird on one side of the spike with the small, slender head on the other side, and show that there is the same difference between the corresponding parts of the arrow.

Point out that when the wind blows, **these big, broad parts catch more of it than the other parts,** *and so* **they are blown back** *as far as they will go. It is in this way that the head always faces the wind.*

N.B.—*The children should be encouraged to make a rough-and-ready paper contrivance for themselves, similar to the one just used. In doing so, point out that the one thing necessary is to make the slits nearer the head than the tail. It will then move easily round on a smooth lead-pencil when it is blown, and always face the person who is blowing.*

IV. The Wind and the Weather

1. Now tell me: When we look at the vane on the top of the school, what do we learn from it? We learn **which way the wind is blowing.**

Yes, but we learn more than that; for when we know from which direction the wind is coming, we also know **what weather we are likely to have.**

The wind has so much to do with the weather, that we sometimes call the vane on the top of a building **a weather-cock.** It points out which quarter the wind is blowing from, and that is quite enough to tell us what weather is coming. Let me explain.

2. The winds which blow **from the north,** come from a part of the world where there are **ice and snow all the year round.** These are **cold, biting, freezing winds.** You know the little song that begins—

> The north wind doth blow
> And we shall have snow.

The south winds blow from the warm, sunny lands in the south, where ice and snow are never seen. They bring us **warm weather.**

The east winds blow from a cold quarter of the world. They are **very dry, stinging winds.** They chap our hands and faces and lips.

The west winds come across **the great wide sea.** They are **wet winds,** because they are **loaded with clouds of vapour,** which they have sucked up from that great body of water. These are the winds **which bring the rain.**

Summary of the Lesson

1. The vane or weather-cock tells us which way the wind is blowing.

2. It is called the weather-cock, because when it shows us the quarter from which the wind is blowing, it also tells us what kind of weather is coming.

3. The north wind comes from a cold part of the world and brings us cold weather and snow.

4. The south wind brings us warm weather; the west wind brings rain.

5. The east wind is a dry stinging wind which chaps our hands and faces.

LESSONS ON THE MEANING AND USE OF A MAP

Lesson XXIV

PLANS

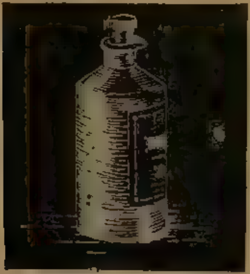
Never draw a plan on an upright black-board. It can only mislead these young children.

Provide for illustration two or three common articles, *e.g.* a large ink-bottle, a chalk or pencil box, and a pickle-jar; a box of coloured chalks, a large sheet of drawing-paper ruled in inch squares, and some drawing-pins; a foot-rule, and a photograph or other picture of the class-room if possible. The children should be provided with pencils and rulers, and paper ruled in quarter-of-an-inch squares.

I. Plan and Picture

1. *Place two or three common articles, such as a large ink-bottle, a chalk or pencil box, and a pickle-jar, conspicuously on the table before the class. Then without saying anything about the*

things themselves, commence to draw them roughly one by one on the black-board. While doing so proceed as follows:—



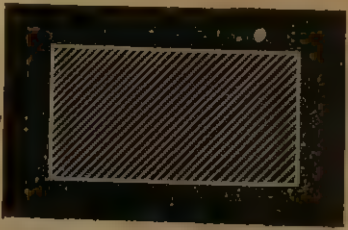
PICTURE OF THE BOTTLE.

PLAN OF THE BOTTLE.

What am I drawing here? The ink-bottle.

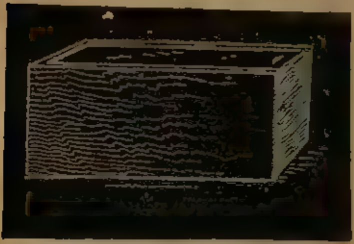
How do you know? Because the drawing is **exactly like the bottle.**

What might we call this drawing? **A picture of the bottle.**



PLAN OF THE BOX.

2. *Deal in a similar way with each of the other articles, and point out that in every case a rough picture of the thing,* **just as it appears to us,** *has been put on the black-board. We can tell at once what it is,* **because it is like the thing itself.**



PICTURE OF THE BOX.

3. *Now run a chalk-line round each of the things,* **to mark where it stands on the table,** *and then*

set the things themselves aside, and call attention to what has been done.

Look at this drawing. Is it anything like the ink-bottle? No.

Then **it cannot be a picture** of the bottle. What is it? It is **a drawing of the bottom of the bottle**—the part which stands on the table.

What does this drawing show us? It shows us **the shape of the bottom.**

Look again. What else does it show? It shows **the size.**

Yes, and it also shows **the exact place where the bottle stood.**

Follow rapidly on the same lines with each of the other things, and then explain that drawings like these, which show

PLAN OF THE PICKLE-JAR.

PICTURE OF THE PICKLE-JAR.

the **shape** *and* **size** *of the bottom of a thing, and* **the position in which it stands,** *are called* **plans.**

4. We have here **plans of the ink-bottle, the box,** and **the jar,** but these plans are not at all like the things themselves. We could not say this is a bottle, this is a box, this is a pickle-jar, **because a plan is not a picture.**

Each of these plans is a drawing which shows **the**

shape, size, and position of that part of the thing which stands on the table—nothing more.

Suppose now I promised to show you a plan of this room. What would you expect to see? A drawing that would tell us **the shape, size, and position of the floor, and the things that stand on it.**

Well, instead of showing you a plan of our room, I am going to ask you to help me make one.

II. A Plan of the Class-room

How did we make a plan of the box and the ink-bottle? We stood them on the table, and made a chalk-line round them.

Well, we cannot of course place the room itself on this table, and yet I will show you how to make a plan of the room, which shall tell us the **shape, size,** and **position** of it.

1. *A large sheet of drawing-paper,* **ruled in inch squares,** *should be* **spread out on the table,** *and fastened down at the corners with drawing-pins.*

Explain that the first thing to do will be to measure the four walls of the room.

Produce the foot-rule, and proceed to measure one of the long walls with it. Show that it takes a certain number of these lengths—say twenty—to reach from one end of the wall to the other. We say **the wall is twenty feet long.**

Now measure the opposite wall, and show that this one is also **twenty feet long.**

Proceed next to measure the other two walls in a similar way, and note their length—**say fifteen feet.**

2. *Point out that it would be impossible to measure twenty feet and fifteen feet on our sheet of paper*—**the paper would be much too small.** *What shall we do?*

Call attention to the ruler itself. Show that it is marked out into **twelve parts, all the same length.**

Explain that each of these parts is called **an inch.** *We say that there are* **twelve inches in one foot.**

Now show that the sheet of paper is **ruled out into squares, exactly the size of one of these parts.**

3. Suppose we let a side of each of these squares on the paper **stand for the length of the ruler.** How many squares shall we want to show the length of the room? **Twenty squares.**

Count twenty squares on the paper, and mark off the line thus obtained in coloured chalk or pencil.

This line made by twenty squares stands for the wall of the room which is twenty feet long. We have made **one inch stand for one foot.**

How many squares shall we want to show the wall next to this one? **Fifteen squares.**

Why? Because that wall is fifteen feet long, and **one foot on the wall means one inch on the paper.**

4. *Call upon the children to point out the direction in which this line should be drawn on the paper, and then count the squares, and put in the line as before.*

It will be an easy matter to complete the figure on the paper now, by leading the children to notice that the other walls of the room are opposite these two.

When this is done, point out that we have now a drawing on the paper showing us **the exact shape of the floor of the room.**

Then if we remember that every inch in the drawing stands for a foot in the room itself, **we know the size of the room** by counting the number of inches in the drawing.

We say the figure is **drawn to scale,** and **the scale is one inch to a foot.**

5. But what else must a plan show besides shape and size? It must show **position.**

Now the best way to learn the position of our room

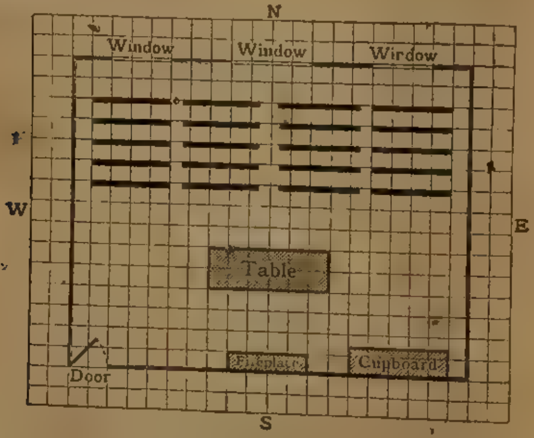
will be to find out the directions in which the four walls are built.

Very well. Suppose you all point to the north side of the room.

Now come and show me this side in the drawing.

Then if we turn the drawing round, so that **this side may face the north side of the room,** we shall at once know where to find the other three points, east, south, and west.

Let this be done, and have the four points N. E. S. W. marked on the drawing.



Our drawing now shows us position, as well as shape and size. **It is a plan of the room.**

It will be interesting and instructive now (while the plan is still lying on the table) to call upon the children to point out, on the drawing itself, the position of various things in and belonging to the room, such as the **doors and windows,** *the* **fireplace** *and* **cupboards,** *the* **table,** *the* **scholars' desks,** *and so on. These of course should all be added to the drawing one by one.*

When the plan is completed, let the children examine it, and

observe for themselves how different such a drawing looks to a picture of the room. **It is a plan, not a picture.**

It might even be possible (in these days of amateur photography) to show an actual picture of the room, and let the children compare it with the plan.

6. *It would be a useful exercise now to set the children to draw the same figure with pencil and ruler, on their own squared paper, at the teacher's dictation, counting square by square.*

When it is finished, point out that **their drawing is exactly the shape of the one on the table**—*it is* **exactly the same shape as the room.** *It is smaller than the one on the table,* **because the squares on their paper are smaller.** *But every one of their squares* **stands for a foot on the floor itself,** *and so* **we can tell the size of the room** *from the drawing. Their drawing, like the one on the table, is* **a plan of the room.** *It is* **drawn to scale,** *but it is four times smaller than the one on the table, because the squares on their paper* **measure only a quarter of an inch** *instead of an inch.*

We can make a plan to any scale we please.

Summary of the Lesson

1. A plan shows the shape and size of the ground on which a thing stands.

2. Plans must be drawn to scale if they are to show size as well as shape.

3. We can make a plan to any scale we please.

4. The four Cardinal Points are always marked on the plan to show position as well as shape and size.

Lesson XXV

MORE ABOUT PLANS

Never draw a plan on an upright black-board. It can only mislead these young children. *(See last lesson.)*

The teacher will require the chalk-box of the previous lesson, a yard stick, several sheets of drawing paper [illegible] [illegible] squares, a rough [illegible] plan of the neighbourhood round the school, and drawing pins for fixing these plans to the table or to a small board [illegible] upon the table.

I. PLAN OF A HOUSE AND GARDEN

The real nature of a plan is so difficult for these young children to grasp, that it will be worth while to spend the time of

[illegible]

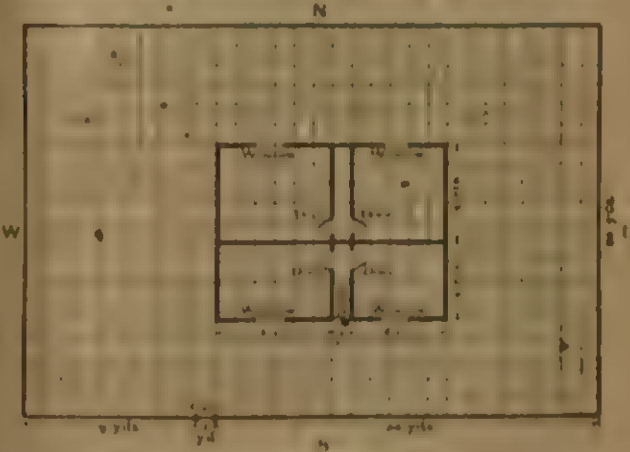
[illegible] [illegible] [illegible] taught [illegible]

[illegible] *of the cottage and garden* [illegible] *children to point out* [illegible] — *the* **door and windows**, *the* **roof, chimneys, and weather-cock**, *the* **garden fence and gate**, [illegible]. *Then proceed as follows:*

This drawing shows us exactly what the real house would look like if we could see it. It is **a picture of the house.** Let us next try to make a plan of it.

You remember in our last lesson we made a plan of this box. Which part of the box did the plan show us? **The bottom of the box.**

Place the box on the table, and run a chalk line round it as before. And then point out that the plan of the box, thus made,



PLAN OF THE HOUSE

really shows the **shape and size** *of that part of the table, on which the box stood.*

Now let us think of the house. If we make a plan of this what will it show us? The **shape and size of the ground on which the house stands.** Quite right. You remember too that we next made a plan of this room.

What did we do before we began to draw the plan? We measured the length of the walls all round the room.

Well, we will suppose we have measured the walls of our house, and we find that **the front wall is twelve yards long,** and **the side wall nine yards.**

2. What must we do now? We must settle how large the drawing is to be.

How can we do that? We must **make a scale.**

How did we make a scale for the plan of this room? We said that **every inch on the drawing should stand for a foot in the room itself.**

What scale did we call that? **An inch to a foot.**

Show a yard-stick and compare it with the foot-rule. Tell that as the house is twelve yards long and nine yards wide, we should have **to move this stick twelve times along one wall,** *and nine times along the other, to get the measurement of the house.*

Show the sheet of drawing-paper ruled in inch squares, and **fix it on the table as before.**

We will make our plan to-day on the scale of **one inch to a yard.**

Will that be smaller or larger than the scale we used in our last lesson? Smaller.

Why? Because **every inch will stand for a yard now**—not a foot.

3. *The rest will be very simple. Lead the children to explain how the plan is to be made on the squared paper, by counting* **twelve squares in one direction** *and* **nine squares in the other.** *Then rule in the lines with coloured chalk, and show that the oblong figure thus made is* **the plan of the house.** It shows the **shape and size of the ground on which the house stands.**

4. But is there not something else to do before the plan is complete? Yes; we must show **position** as well as shape and size.

How can we find out the position of the house? By noticing the **directions in which the walls are built.**

Call attention to the weather-cock on the top of the picture of the house. Notice that the letter S. points to the front of the house, and lead them to tell the rest. Put in the four cardinal

points by the side of the plan, and then show that our plan tells us all we want to know—**shape, size,** *and* **position.**

5. *The time would be very profitably spent in enlarging upon this simple plan.*

Tell that inside the house itself **a long passage extends** *from the front door to the back; and that there are* **four rooms,** *two on each side of this passage of such and such dimensions. Explain that our plan can show us all this.*

Measure the details out in squares according to the scale, and rule the lines in with coloured chalks as before.

The position of the **windows,** *and also of the* **doors leading to the rooms,** *might next be shown, and so on.*

6. *Lastly proceed to mark out on exactly the same lines* **the garden surrounding the house.**

Here we have a complete **plan of the house and garden.** It shows us **the shape, size,** and **position of every part,** and yet it is **not at all like the house itself** or the garden. **It is only a plan**—not a picture.

We have **straight lines to stand for walls,** and **other marks** to show **windows, doors, fence,** and **gate;** but these lines and marks are not at all like the things themselves.

II. Plan of School and Playground

This should form an important step in the teaching, but of course the teacher must, in every case, be left to his own resources. It is impossible to do more than guide him here.

He will deal with the school and its surroundings on the lines already laid down, and the children themselves should be led step by step to assist in the preparation of the plan.

A smaller scale should be employed for this—say **one inch to ten feet;** *the squared paper should be used as before; and* **above all things the plan should still be drawn on the table, and not on an upright black-board.**

III. Plan of the Neighbourhood

In almost all cases it would be impossible to draw this (as the other plans have been drawn) in and during the lesson, with any advantage to the class. The teacher should prepare beforehand a carefully drawn plan of his own, and it is very advisable that this should not be made too intricate.

1. *All that is necessary is to show the school and playground in the centre of the drawing, and a few of the main roads and streets leading from it in different directions.*

A scale of **one foot to half a mile** *would thus give a plan two feet square, and in most cases this would be found to embrace quite as much of the district as the children need be required to know.*

The teacher should take care to have **a fairly accurate knowledge of the distances of a few well-known points, public buildings, churches, and so on,** *and the rest might very well be given approximately.*

In making use of the plan during the lesson, **let it be placed, like the others, upon the table—not hung up in front of the class**—*and if necessary let the children be grouped round it.*

2. *After first seeing the plan fixed in the proper position on the table*—**north pointing to north**—*call attention to the school and playground in the centre.*

Notice what a little room they take up in this drawing, and let that lead to an explanation of the new scale. This done, it will be an easy matter to deal with the details of the plan.

3. *The children will take a lively interest* **in finding their way along these roads and streets** *to and from the school, and also in telling the direction in which they are going. They will be especially interested, if one or two of their own streets are selected, and they are asked* **to show on the plan the way they come to school.**

Scores of similar devices will, however, readily suggest themselves to the teacher, to familiarise the children with the meaning and use of this plan.

4. Now let us see what this drawing really is. It shows us a square, which measures **one mile each way.** It has the school marked in the centre, the roads and streets leading from it in different directions, and it shows the churches and other buildings in their proper position.

It is a plan like the other drawings we have made; but I want you now to learn a new name for it.

This plan, which shows us **the position of different places, the direction in which they lie from one another,** and **the distances between them,** is called **a map.** It is **a map of the streets and roads near our school.**

SUMMARY OF THE LESSON

1. A plan is another name for a map.

Lesson XXVI

PLANS AND MAPS

Plans and maps are still to be shown on a flat, level surface. They should not yet be hung up, or drawn on an upright board.

Provide the teacher with the plan of the neighbourhood used in the last lesson, the map of the river, and the model and picture of the same river as used in Lesson XIX. A foot-rule will also be required.

I. RECAPITULATION

1. *SHOW the plan of the neighbourhood, which was used in the last lesson, and proceed as follows:—*

What is this? A map of the streets and roads near the school.

What do you mean by a map? **A map is a plan.**

What three things does a plan show? **Shape, size, and position.**

Point out that the first of these—the shape—can be seen at a glance. The plan itself is square, and it shows all the streets and large buildings inside the square. The little oblong in the centre of the drawing points out where the school stands, and it is **exactly the shape of the ground on which the school is built.** *So of the churches and other large buildings if there be any.*

2. How do we learn the position of different places from this map? The four points—north, east, south, and west—are marked on the map, and they tell us the position of every place in it.

What else do we learn from these four points? We learn **the direction in which every road and street runs,** and the direction from one place to another.

3. Now, last of all, how can we learn the size of the place by looking at this map? The **scale tells us this.**

What is the scale for this map? **One foot to half a mile.**

What does that mean? It means that **every foot in the map stands for half a mile.**

Measure with the foot-rule north, south, east, and west from the school, and show that this square, which is only two feet across, stands for a large district round the school, **measuring one mile in every direction.**

Tell that we call this large district **a square mile.** *Our foot-rule would at once tell us* **the length of all the roads and streets** *that are marked in the map,* **and the distance between any one place and another.**

II. Map of Hills, Valley, and River

1. *Show the model of the river that was used in Lesson XIX., and lead the children to tell all they can about its various features.*

When we look at the model we can almost fancy we are looking at the river itself, because we see everything as it really is.

Now uncover the plan or map of the river, which has been drawn in chalk, side by side with it, and proceed to point out the difference between the model and the plan.

The one shows everything just as it really is—the other simply tells us, **by means of certain lines and other marks,** the **position in which different things stand.** The plan is not in any way like the thing or things it stands for.

Remind the children that in our plan of the streets and roads round the school we had, in like manner, only **two parallel lines** *to show us* **a long road,** *which has shops and houses from one end to the other.*

2. This is a plan or map of the river and the land all round it. Let us see what we can learn from it.

Call one of the children to the front, and lead him, by comparing the two, to point out first of all **the wavy lines in the plan,** *which stand for* **the winding river and its feeders,** *as they are shown in the model.*

Notice that these wavy lines **are no more like an actual river,** *than the two parallel lines on the other plan* **are like a road.**

They show us exactly **how these streams run and wind about.**

They tell us **the shape of the river and its tributaries or feeders. That is all.**

3. *Show the picture of the river now.*

Call attention to the hills on either side of the river, and in the distance. Notice the trees, the grassy slopes with the sheep feeding on them, and other prominent features of the scene.

Now ask the child to point to the same hills on the plan or map.

These strange **shaded lines** are **not at all like hills** of course; but we know what they stand for, and they tell us **the shape of the land.**

When we look at a map like this, we know at once the nature of the ground. We can tell **which part of it is hilly** and which is flat.

Notice that in some places the shading is deeper and wider than in others. The reason for this may be explained and made quite clear to the children, by calling attention to the shadow which the sun throws on one side of a bank or ridge of ground, which is higher than the rest.

This shading is meant to represent on our map the shadow that would be cast by these hills. The higher the hills, and the more rapidly they rise, the deeper is the shading marked on the map.

Our map tells us at a glance all we want to know about **hills, valleys, plains,** and **rivers.**

4. Now tell me: What else do we learn from a map? We learn **the direction in which one place lies from another.**

How do we find that out? By the four cardinal points.

Show these points on the map itself, and exercise the children (only to the extent of the previous teaching of course) in pointing out the direction in which certain windings of the river flow, and certain parts of the hills extend.

5. Now, lastly, a map should show us **size** as well as **shape, position, and direction.**

How shall we learn this? By looking at the **scale.**

Tell me what the scale says? **One inch to five miles.**


Hills
Source
Feeder
Plain
Feeder
Feeder
Hills
Hills
Town
Hills
Hills
Hills
Town
Town
Feeder
N
W
E
S
River

What does that mean? It means that **every inch on the map stands for five miles.**

Show that, as we know this, it would be easy to measure the length of the river through all its windings, and from any one point to any other point. Our map **tells us everything we want to know,** *although it is not at all like the picture.*

6. *Call attention to* **the little towns on the river,** *as they are shown in the picture; and then point out how they are represented in the map by nothing more than* **a round dot.**

Explain that this dot **stands for the whole of the ground on which the town is built,** *with all its streets and houses; but as our scale is one inch to five miles, we can only point it out in this way.*

STAGE II

LAND AND WATER

Lesson I

THE SEA

The teacher should be provided with the modelling tray and the No. 1 model of the coast. Some water, a tumbler of strong brine, and a large basin will also be required. Brown's Picture, "Cliff, Headland, Bay, and Gulf," will be useful for recapitulation purposes.

I. THE EDGE OF THE LAND

1. *Commence with a few words about rivers, for the purpose of eliciting what a river is, where it comes from, and more especially what becomes of it at last.*

Rivers **flow into the sea.** In whatever direction a river may run, it must at last reach **the end of the land.** There is no more land for it to flow through, and it then **pours its water out into the sea.**

2. *Imagine four men setting out from the school to walk as far as they could go in four different directions—north, south, east, and west.*

On their way all four might have to **climb high hills,**

dip down into **low valleys**, and perhaps walk for many miles across **flat, level plains.**

But each one would find himself at last on **the very edge of the land.**

He would be unable to walk any farther in the same direction, because he would have before him **nothing but water** — not the water of a running stream, like the rivers over which he easily crossed during his walk by means of bridges, but a great sheet of water stretching as far as his eyes could reach.

3. This **great sheet of water is the sea,** and in whatever direction we walk, if we walk far enough, **we must come to the sea at last.**

The edge of the land, which touches the sea, is called by different names—the **coast,** the **shore,** the **beach,** and the **sea-side.**

4. *Show the model, and let the children point out on it the sea and the coast-line near it. Observe that the coast is not everywhere alike. In one place it is* **high and rocky**; *in another it is* **a low sandy shore,** *which stretches away to the very edge of the water.*

We call the high rocky parts the **cliffs**; the low shore the **sands**; but it is all part of the **coast** or **coast-line— the land nearest the sea.**

5. *Ask the children to imagine themselves (with the help of the model) to be standing on the edge of one of these tall cliffs, and looking out to sea. Picture the* **curve of the sky** *bending down in the far distance, till* **sky and water seem to meet.**

What name shall we give to that line, where the sky seems to touch the water? **The horizon.**

II. The Tide

1. *The thing which usually impresses a child most when he pays his first visit to the sea, is the constant washing of the waves on the shore. Deal with this now in some such way as follows:—*

I throw a stick into a pond. What happens? The stick floats on the top of the water, but **does not move.**

Why not? Because the **water of the pond is still** or **standing water. It does not flow.**

2. What would happen to the same stick if I threw it into a river? It would **float away** out of sight.

Why? Because rivers are **flowing streams of water.** The water, as it flows, carries the stick away.

In which direction do rivers flow? They always flow in one direction—**downwards from the source to the sea.**

3. *Now picture to the children the water of the sea.*

It is **never still.** Day and night, summer and winter, all through the year, **the waves are constantly rolling up on the beach.** It is a grand sight to watch the waves roll up, and break on the shore in white foam.

We say that **the sea washes the land.**

4. *Proceed next to elicit step by step, from those who have been to the sea, that at one part of the day,* **people can walk out a long way** *on the sands, but that later on in the same day there is* **nothing but water to be seen there.** *The sea comes in closer to the land, and covers the place where the people were walking about a few hours before.*

This will lead to the natural inference that the water of the sea **does not flow in one direction only,** *like the water of the rivers, but in two directions*—**up and down.**

5. *Explain that for six hours every wave which rolls in comes*

a little farther up the beach *than the one before it, and that in this way the water gradually* **flows up,** *or* **rises,** *higher and higher, till at last it reaches its highest point.*

All this time we say **the tide is flowing,** or **rising,** and when the water has reached its highest point, it is seen to be close up to the land everywhere along the coast. We then say it is **high tide** or **high water.**

Tell that if we watch the waves at high tide, we always notice that although they keep rolling in one after another as before, **the water does not rise any higher.** *It remains at the same level.*

This goes on for about **ten** or **twelve minutes,** and the tide is said to be **turning,** because at the end of that time each wave begins to fall a little short of the last, and so **the water does not come so far up on the shore.**

6. *Explain that for the next* **six hours** *every wave falls a little short in this way, and so the water by degrees gets lower and lower, and more and more of the beach is left dry.*

We then say **the tide is ebbing** or **falling,** and at the end of the six hours **the water reaches its lowest point.**

This is the time when people are able to walk out a long way on the sands. It is **low tide** or **low water.**

7. *Explain that after remaining at low-water mark for about* **ten or twelve minutes,** *the tide* **begins to turn** *once more, and* **for the next six hours** *it* **rises,** *or* **flows in** *towards the land as before.*

This flow and ebb of the tide goes on without ceasing, day after day, year after year, so that **every twelve hours the water rises and falls once.**

8. *Notice that at every turn of the tide there is a loss of a few minutes, and that in consequence of this,* **each tide is always a little later** *than the last, as the water takes fully* **six hours to flow,** *and* **six hours to ebb.**

But allowing for this we can tell the exact minute, day

by day, when it will be high tide or low tide, and we can even tell how high the water will rise.

III. The Rivers Feed the Sea

1. I stand a saucer of water out in the sun. What happens? The water passes away in **vapour,** and leaves the saucer dry.

Think then of the wide-stretching sea, where there is nothing but water to be seen on every side, as far as the eye can reach.

What must be always going on there? The sea must be always **losing some of its water in vapour.**

What becomes of this vapour? It rises in the air and **forms clouds.**

2. *Point out that the sea provides by far the greater part of the moisture which forms the clouds—that there could be no clouds to speak of without the sea.*

Then, as the sea is constantly losing its water in this way, how is it that it does not dry up, as the saucer of water would?

Lead the children, step by step, to tell the reason. The **clouds fall in rain,** *the* **rain makes rivers,** *the* **rivers flow** *through the land, and* **pour out their water** *at last* **into the sea again.**

The **rivers feed the sea.** There is as much water poured into the sea day by day from the rivers as is taken out of it in the form of vapour. **Hence the sea can never dry up, nor can it ever be too full.**

IV. Sea-Water always Salt

1. *Refer to the lesson on* **Salt Water and Fresh Water,** *and remind the children that in it we spoke of the saltness of the sea.*

Sea-water is always salt, nearly as salt as brine. We could not drink it. The water of **springs** and **rivers**

is not salt. It is **fresh water.** This is the water which provides us with drink; it has no taste whatever.

Elicit, from what has already been taught, the reason for the saltness of sea-water.

Deep down in the crust of the earth there are **great beds of rock-salt,** and the water, as it trickles through the earth on its way to the sea, **dissolves some of this salt,** and carries it away in solution. It is **this dissolved salt that makes the sea-water salt.**

2. *Produce the tumbler of strong brine, and let the children taste it. Pour this brine into a large basin, and proceed to dilute it with tumblers of fresh water, letting the children taste it after each addition, and explain what they observe.*

The water gets less and less salt every time, till at last we can barely taste any saltness in it.

Now remind them that, as the sea is day by day being filled up with fresh water from all the rivers, we should naturally expect that this would in time make the water of the sea less and less salt.

We know it is not so—that in spite of all this fresh water pouring into it, **the sea is as salt as ever it was.** How is this?

3. *Refer again to the same lesson, and lead the children to tell the reason why we were able to get the dissolved salt back by boiling the solution.*

The **vapour** that rises from water **never takes anything away with it.** Whatever may be mixed with the water—whatever may be dissolved in it—whether sugar, salt, or anything else—it is all **left behind**; nothing but water-vapour can pass away.

4. *Show from this:—*

(*a*) That although such vast quantities of water-vapour pass away from the sea to form clouds, **all the salt is left behind.** Not a particle of it rises in the vapour.

(*b*) That all this salt left behind from day to day does

not make the sea salter and salter, because **just as much fresh water is poured into it** by the rivers as is taken out of it **in the form of vapour** to make clouds.

In connection with all this ask the children to catch some rain-water as it falls from the clouds, and taste it for themselves. It does not contain a particle of salt although it came from the salt sea. **It is fresh water.**

Summary of the Lesson

1. **The coast** is the land nearest the sea.
2. The high, rocky parts of the coast are called **cliffs.**
3. **The tide of the sea** ebbs and flows twice every twenty-four hours.
4. The rivers feed the sea; the sea feeds the clouds.
5. The sea-water is always salt, because the vapour does not take away from it any of the salt, when it rises to form clouds.
6. The rain which comes from the clouds is fresh water.

Lesson II

THE SEA AND THE LAND

The following articles will be required for illustration: the modelling tray, and No. 1 model of the coast, with some clay, sand, chalk, and pebble-stones; a garden watering-pot; two or three pieces of sandstone; a hand lens; a round boulder stone; some pebbles and shingle. A freezing-mixture should be prepared with equal quantities of pounded ice and salt, and before the lesson commences a well-corked soda-water bottle filled with water should be immersed in it. Brown's Picture of "A Stormy Coast."

I. Introduction

1. *Commence by introducing the model, and make it the connecting link between the new lesson and what has already been taught.*

What name do we give to the land nearest the sea? The **coast, or coast-line.** Let us trace this coast-line in the model.

What sort of line would you call it? A very **crooked and broken line.** It runs first in one direction and then in another.

Notice that in one place **the land stretches out** *a long way* **into the water,** *while in another* **the water runs up into the land.** *It looks as if a great bite had been taken out of the land, just as we take a bite out of a slice of bread, and that the sea had flowed in to fill up the gap.*

2. *Notice next that one part of the coast is* **high,** *another part* **low,** *and elicit that the higher parts are called* **cliffs.**

Tell that some cliffs rise many hundreds of feet above the sea, and they are always very **steep** *and* **rugged;** *that some are made of* **hard, stony rocks,** *others of* **chalk.** *Show both in the model.*

3. *Lastly, call attention to the* **low-lying shore,** *which stretches down to the edge of the water. Point out that this consists mostly of* **sand and shingle,** *and then notice that near the base of the cliffs the shore is* **strewn with huge rough masses of rock,** *which look as if they have been broken off from the cliff itself.*

The land nearest the sea **wears away little by little,** and it is this which breaks the evenness of the coast-line. Let us find out how it all happens.

II. Some Experiments

1. *Pile up some clay, sand, chalk, and stones (large and small), in a compact heap on a slightly tilted board or tray, and let one of the children pour water on the heap from the watering-pot, calling upon the class at the same time to observe and tell what takes place.*

(*a*) The water **washes away the sand** in a very short

time, and leaves hollows between the clay, chalk, and stones.

(*b*) It washes **little particles of the clay and chalk away** too, as may be easily seen from the colour of the water which flows from the tray; but **it takes away so little** that it would be a very long time before it could wash all the clay, or all the chalk away, as it did the sand.

(*c*) The water **seems to have no effect at all on the stones**; they all remain just as they were at first.

2. *Remove the soda-water bottle from the freezing mixture now, and point out that it has* **burst.** *Remind the children of the* **bursting of water-pipes in frosty weather,** *and explain (of course in the simplest way possible) that* **when water freezes,** *and becomes solid ice,* **it swells out,** *and wants more room.*

Show that the water in the bottle has been frozen into ice. The solid ice may be seen oozing through the split in the bottle. **The bottle burst, because it could not stretch to make more room for the ice, as it froze.**

Tell that if water becomes **lodged in the cracks and crevices** *of the hardest stone,* **the next frost will cause the stone to split,** *as easily as the bottle was split by the freezing water in the basin.*

3. *Take two pieces of sandstone, and rub them together over a sheet of white paper, calling upon the class as usual to note what happens.*

Little rough particles, or **grains,** fall from the stones as they are rubbed.

Have these grains examined with the help of a magnifying lens, and compare them with the **grains of sand** *in the saucer. Both are alike in every particular.*

These little rough grains, which we made by rubbing the stones one against the other, are **actually grains of sand.** This sand in the saucer **was once solid stone or rock,** like the pieces we have been rubbing.

All the sand on the sea-shore has been **made from the solid rock** or **stone,** which forms the cliffs.

III. A Storm at Sea

1. *Refer once more to the river, and lead the children to describe the calm, quiet way in which it flows on, day after day, with scarcely a ruffle on its surface.*

Contrast this with the sea, which is **always changing.** *At one time its surface is almost as smooth and unruffled as the surface of the river. Then a wind springs up, and* **the water is blown along in waves,** *and the stronger the wind the bigger the waves.*

Show the children how they can **make little waves for themselves,** *by blowing on the surface of some water in a tub.*

2. *Tell that sometimes the wind is so strong, and the waves are driven along with such force, that the sea itself, instead of being smooth,* **looks like great hills of water with deep valleys between them.**

A brisk wind is called **a gale; a very strong wind is a storm.**

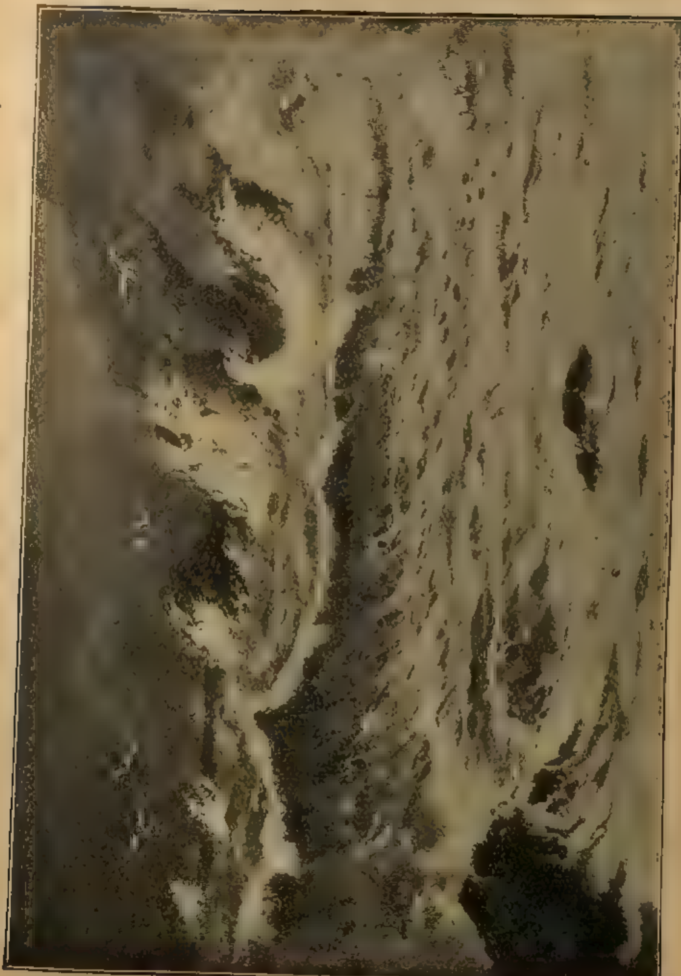
Show a picture of a storm at sea, with **the great waves** *leaping up and* **dashing over the rocky shore,** *and call special attention to the force with which the raging mass of water beats upon the land.*

N.B.—*The teacher should remember that it is no part of our present plan to deal with the storm in its relation to ships and sailors. That will come in its place later on. Our present object is simply to account for the varying nature of the coast-line, and it is best to deal with one thing at a time.*

IV. The Destructive Force of Water

1. *It will be an easy matter now to lead the children themselves to tell the rest of the story.*

Remind them, to begin with, of the experiment with the watering-pot, and elicit that although the water seemed to have no effect



A STORMY SEA.

on the hard stones, it washed away more or less of the other materials—**the sand in large quantities,** *and* **some of the chalk and clay.**

Compare this with the waves beating on the sea-shore, and elicit that they too **wash away the sand and soft earth in immense quantities,** *while they seem to have very little effect on the hard rocks.*

2. *Explain that those great bites in the coast-line have all been made by the sea; and that the land there was once formed of materials which* **the sea could easily wash away.**

It washed them away, and as it did so it rushed in, to fill up the gap which was made.

3. *Point next to the* **long tongues of land which stretch out into the sea,** *and lead the children to infer that the reason why these are not also washed away by the waves, is that* **they consist of hard rock** *and not loose, soft material.*

4. *Picture the waves beating against the base of a chalk cliff.*

Their work is slow but sure. They **wash away the chalk, little by little,** often making **great holes in the cliff,** which we call **caves.** Sooner or later they end by undermining the cliff, and then all of a sudden **a great mass of it falls.** (*Show the caves in the model.*)

5. *Pass on next to consider the action of the* **winter frosts on the harder rocks.** *Lead the children to tell what they know, and then explain that this is always the cause of much damage on a rocky coast.*

Every spring fresh masses of rock may be seen strewing the shore, to tell of the **work which the winter's frosts have been doing.**

6. *Lastly, call attention to the* **sand** *and* **shingle** *of which the low-lying shore itself is composed. Point out that* **the**

great pieces of rock *which fall from the cliff are* **roughly broken,** *with* **uneven surfaces** *and* **sharp, jagged edges.**

Then show, if possible, a **boulder,** *a* **few large pebbles,** *some* **shingle,** *and lastly some of the* **sea-sand.**

These have no sharp, rough, jagged edges; they are all **smooth** and **rounded**; their rough edges have all been worn down. Yet they all came from the rough pieces which fell from the rocks above.

7. What can have made the change?

Tell that **the waves have done it all.** *As they beat upon the shore, they dash these stones about, like feathers in the wind, and every time one stone rubs against another,* **its rough edges are chipped and rubbed off,** *till in time it becomes* **smooth and round like these pebbles.**

Nor does it end here, for the same ceaseless action of the waves chips, breaks, and wears down these pebbles themselves, and reduces them to **fine grains of sand,** *just as we did by rubbing the two stones together.*

Summary of the Lesson

1. The coast is uneven because the sea wears it away little by little.

2. It wears away the softer parts of the land more easily than the hard rocks.

3. Wherever the sea wears away the coast, it flows in to fill up the gap; but the hard, rocky parts of the coast stretch out into the sea, because they are not worn away.

4. The winter frosts split and break the hard rocks.

5. The broken pieces of rock are dashed about by the waves. They rub against one another till they become smooth, round pebbles.

6. Sand is made from pieces which have been broken off from these rocks, and ground up into fine grains by the waves.

Lesson III

THE COAST

Provide for illustration: the modelling tray, with No. 1 model; some sand, shingle, and pebbles, and the toy ships.

I. Introduction

1. *Produce the model, and at once begin, by means of a few well-chosen questions, to refresh the children's memory on the subject of the preceding lesson, the purpose being to impress upon the class once more that* **the uneven coast-line,** *the* **rock-strewn shore,**—*even* **the sand, shingle,** *and* **pebbles** *that make the shore itself,*—**all are the work of the waves.**

2. *This done, point out that, when we speak or read about different things of any sort, we are able to tell one thing from another without seeing either a picture or a model, because each one has its own name, and the name calls up in our mind a picture of the thing itself. Give one or two examples of common things.*

Tell that, in like manner, names have been given to all the different parts of the coast, in order that whenever we hear the name of any one of them, we may at once form a picture of it in our mind, and so understand what is meant.

We will now learn the names that are given to these different parts of the coast.

II. The Land that Touches the Sea

1. **The Shore.**—Let us commence with the low-lying part of the land, which stretches down to the water's edge.

This is known by various names—the **shore,** the **beach,** the **strand,** the **sands,** and so on.

If we turn to our model we see that in one place the shore consists of **fine sand** from the foot of the cliff to the water, while in another there is no sand at all—nothing but **shingle or pebbles.**

Show a handful of shingle, and point out that they are always smooth, rounded stones, **made so by the wash of the waves.**

Tell that in some places on the actual sea-shore the shingle consists of small stones like these, but in others the shore is made up of great rounded pebble stones, **bigger than a man's head.** *These are called* **boulders.**

A **pebbly shore** of any sort is properly called **a beach,** but people do not always confine the name beach to this kind of shore.

What name do we give to this high, rocky part of the coast? The **cliff.**

Look, here is a great hole in the foot or base of the cliff. What do we call that? A **cave.**

2. **Heads or Headlands.**—Now if you run your eye along the cliff in the model, you will see that part of it **stretches out into the water** a long way beyond the rest, and our model will help us to form a very good idea of what the actual coast looks like.

Place one of the little ships on the imaginary water, and move it slowly towards the shore.

This rocky piece of the coast **stretches out so far into the sea,** and **stands up so bold and high** against the sky, that it must always be **the first land the sailors see** as their ship sails in.

At the first sight of this land, the sailors might almost fancy it to be **some huge beast** rising up from the water, and **rearing its head out towards the sea.**

Tell that there is no doubt some of our sailors in the old old times did actually fancy things of this sort, for wherever they met with **high land stretching out into the sea** *like this,* **they always called it a head,** *and we ourselves still call it by the same name.*

3. **Capes are Heads.**—*Notice that, strangely enough, our early English sailors were not the only people to fancy things of this sort. Sailors of foreign countries also thought that land stretching out into the sea* **looked like a great head,** *and they too* **called it a head,** *although their word for* **head** *is not the same as ours.*

Cape is their word for **head,** and this is the name they gave to it, but remember it means **exactly the same as our word head.**

Cape, head (or **headland** as we sometimes say) are all names given to land which **stretches out into the sea.**

Show a boy's cap. Ask for its name and its use. It is called **a cap**; *it is a covering* **for the head.**

Remind them that there is another article of clothing, with a name almost exactly like this—**a cape.**

Tell that when capes were first worn they always consisted of two parts—**a large hood to cover the head,** *and another part to hang over the shoulders. They were called capes,* **because the part which covered the head** *was thought the most important.*

This homely illustration will help to fix the idea in the children's minds that **cape and head mean the same thing.**

III. The Sea that Touches the Land

We have talked about the land that stretches out into the sea; let us now turn our attention to the parts of the sea that run into the land.

Call one of the children to the front, and ask him to point out examples of these in the model.

1. **Bay.**—Suppose we begin with this large one, which (as we once said) reminds us of **a bite taken out of a slice of bread.** Look at it carefully, and see what you can find to tell me about it.

In this way lead the children themselves to observe and tell:—

(*a*) That it **does not run very far into the land**;

(*b*) That it is **wider at the entrance** than in any other part; and

(*c*) That the **shore bends in** towards the land with **a rounded sweep or curve.**

Tell that a part of the sea, **which runs a little way into the land** *as this does, and is* **wider at the entrance** *than anywhere else, is called* **a bay.**

Illustrate this by referring to the bay-window of a room. The bay portion of the floor does not extend very far beyond the rest, and it is always wider at the entrance than at any other part.

2. **Gulf.**—Here is another place where the sea runs into the land. I want you to look at this one, and compare it with the bay, to see what difference you can find in the two.

The children will have no difficulty in pointing out—

(*a*) That this one **runs a long way into the land**; and

(*b*) That it has **a narrow entrance.**

Tell that **a narrow inlet** *of the sea, which* **runs a long way into the land,** *as this one does, is called* **a gulf.**

3. **A Harbour.**—Now I want you to look carefully at this little inlet.

Which is it most like—a bay or a gulf? A gulf.

Why? Because it has **a narrow entrance.**

Point out that it not only has a narrow entrance, like the gulf, but it is narrower at the entrance than in any other part. It spreads out into a wide sheet of water after it enters the land.

Tell that this is a little gulf too, but because of its narrow entrance it is **very useful to the ships.** We call it **a harbour,** or **a haven.**

Lead the children to think of a storm at sea. Tell that when the storm is raging, the waves are driven along with such force by the fury of the wind, that **big ships are almost helpless**—*they are dashed about as if they were straws on the water.*

Think what would happen if the ship were dashed against the rocky shore. The rocks would break it in pieces; **it would become a wreck,** and all the poor sailors would be drowned.

Whenever they see a storm coming up, the sailors always try, if they can, **to run their ship into a harbour,** and then they are safe, because the raging waves cannot force their way through that narrow entrance. They are **broken up and spent,** as they dash themselves against the rocks, before they enter the harbour, and the **ship can ride there in perfect safety** till the storm is over.

We say the rocks at the entrance to the harbour make a natural **breakwater,** because they **break up the waves** in this manner.

Breakwaters are sometimes **built at the mouths of harbours** to still further protect them. These breakwaters are immensely **strong sea-walls,** built of the hardest of stone.

Point to the breakwater in the model.

IV. A Map of the Coast

1. Our model, you see, has given us a very good idea of what the different parts of a coast-line look like. It is very important that the sailors on the sea should know the coast-line well, but they cannot carry a model or even a picture of it with them.

What else could they have to tell them all they want to know? **A map.**

2. What could they learn about the coast-line from a map? They could learn **its shape, its length,** and **the direction in which it runs.**

How would they learn its length? By means of **the scale.** So many inches on the map would mean so many miles.

How would they learn anything about direction? **The four cardinal points** are always put on the map. They tell direction.

3. Very good. Now to-day I don't wish to trouble you with either the length or the direction of our piece of coast-line. I will simply let you see **how we show the shape of it in a map.**

Draw an outline of the coast in chalk on the board, side by side with the model, and let the children tell where the names **cape, head, bay, gulf, harbour** *are to be written.*

Summary of the Lesson

1. **Shore, beach, strand,** are all names for the sandy or pebbly coast which is washed by the sea.

2. **Caves** are holes worn in the cliffs by the washing of the sea.

3. **A Head** or **headland** is a bold, rocky piece of the coast, which stretches out into the sea.

4. **Cape** is another name for head, or headland.

5. **A Bay** is a part of the sea which runs a little way into the land, and is wider at the entrance than anywhere else.

6. **A Gulf** is a part of the sea which runs a long way into the land, and has a narrow opening.

7. **A Harbour or Haven** is a small opening, where ships may ride in safety during stormy weather. It has a **breakwater** to protect it from the sea.

N.B.—*The time of the next lesson should be devoted to a recapitulation of what has been taught, for the purpose of committing the above to memory, and the children themselves should be called upon (under the teacher's direction of course) to make clay or sand models of capes, bays, gulfs, etc., and also to draw plans or maps of them afterwards on the horizontal board.*

Lesson IV

THE COAST (SECOND LESSON)

The teacher will require the modelling tray and model No. 2, the toy ships, some clay, sand, and water. Brown's Picture, "Peninsula, Isthmus, Straits," for recapitulation.

I. Island

1. *Uncover the model, and commence by calling upon the children to point out in it the now familiar features of the coast-line—capes, bays, gulfs, and so on.*

That done, ask whether they can see anything in this model which they did not see in the last. Lead them to notice one of the pieces of land standing up in the midst of the water.

This land is quite **separate from all the rest.** It is cut off from the rest of the land by the water.

2. Think of a large piece of land like this **in the middle of the sea.** If we were living on it, whichever way we walked **we must always come to the sea.**

How could we get to the larger land on the other side? We should have to go in a ship.

Let one of the children take the little ship across, and back again.

Ask him now to act as captain, and take his ship for a voyage along the coast. Observe that at the end of the voyage **he brings his ship back to the very place from which it started.**

3. This piece of land **has water all round it.** We say it is **surrounded by water,** and we call it **an island.** **An island is land surrounded by water.**

Write the word **is-land** *on the board, with its meaning.*

Tell that the word island means **water-land—land in the midst of the water.** *Call upon the children to point out other islands in the model.*

4. *Notice that some of these islands are much smaller than the others. We call them* **isles.**

An isle is a small island, and **a very small island** is sometimes called **an islet.**

People who live on an island know that their land is only a **part of the larger land on the other side of the water,** and they always speak of that larger land as **the mainland,** that is to say, the principal part of the land.

II. Peninsula

1. Let us leave the islands now, and go across in our ship to the mainland.

Can you see any part of the mainland that looks almost like an island?

Call upon one of the children to point it out.

Why do you say this is almost an island? Because it has **water nearly all round it, but not quite.** There is one part where it is **joined to the mainland.**

2. What joins it to the mainland? **A narrow strip of land.**

Ask the child to point out this narrow strip of land, and let him show that the ship could sail all round till it came to this part, but it would stop there, **because the water is not all round the land.**

Tell that when a piece of land is **almost an island,** *we call it* **a peninsula.**

The words **pene-insula** *mean* **almost an island.** *Write the word on the board, with its meaning.*

3. Now look again at the model, and see whether you can find any more peninsulas—any more land **with water nearly all round it,** but not quite.

Lead the children to pick out the other examples, and to give their reasons for calling them peninsulas—**they have water on all sides but one.**[1]

4. What difference do you notice between these peninsulas and the one we found first? The first one is joined to the mainland by a narrow strip of land; in the others **the whole of one side of the peninsula is joined to the mainland.** There is no narrow strip of land between.

5. Suppose we now look at the first peninsula once more. The narrow strip of land which joins it to the mainland reminds us of **the neck which joins our head to our body,** and that is why people have called it **an isthmus.**

This is an ugly foreign word, but it only means **a neck** after all. I will write it on the board, for I want you to remember it, ugly as it is.

Write it slowly—**isth-mus**—*and let the children spell it several times. Then rub it out, and call upon two or three of the children to come to the front and write it again, while the rest dictate the spelling.*

6. Now I wonder whether any of you are clever enough

[1] The capes and headlands are in reality little peninsulas, for they too have water on all sides but one.

to tell me how a peninsula like this could be made into an island. Watch and I will show you how it can be done.

Pour some water rather roughly against one side of the isthmus, which has been prepared for the purpose with sand, so as to wash it away, and **separate the two pieces of land.**

Call upon the children to observe that the piece of land that was a peninsula **is now an island.**

It is quite separate from the mainland; **it has water all round it;** we can sail our ship all round it, and come back to the same place again.

7. A little while ago we spoke of the islands as being part of the mainland.

Can you tell me now how they came to be separated? **The sea must have washed away the land between them.**

Tell that this is exactly what has taken place at some time or other. The sea has washed away some of the land, and made **a narrow passage of water** *where the isthmus once was, and so land which was once a peninsula* **has been changed into an island.**

III. Strait

1. *It will now be a perfectly natural step to turn to the model once more, and call attention to* **the narrow passages of water,** *which separate the islands from the mainland, and one island from another.*

Tell that these narrow parts of the sea have their names as well as the other parts.

A narrow passage of water between two pieces of land is called a strait.

Write the word, with its meaning, on the board, and be particularly careful to impress upon the class that the word has no connection with the word "straight," although both are sounded alike.

Strait means **narrow. Any narrow part of the sea with land on both sides is called a strait.**

2. *Point out, and show with the help of one of the little ships, that a strait is always* **open at both ends,** *so that ships may sail through the narrow passage from one part of the sea to another.*

3. **A channel,** like a strait, **is a passage of water,** which divides two parts of the land, and joins two parts of the sea. **But a channel is wider than a strait.**

Pour a good stream of water through one of the straits, which has been prepared for the purpose with sand, and show that when the sand is washed away, the strait is widened and converted into a channel.

4. *Tell that the sea,* **by washing away some of the land on either side,** *in time makes the strait wider and wider, till* **it becomes a channel.**

Now let us have one more look at our model. I will fill up the strait between this island and the mainland, and I will join the other one to the mainland by a narrow neck of land. *Use sand or clay for this.*

What have I done in both cases? **Both islands have been changed into peninsulas.**

IV. The Map

As in the last lesson, lead the children again to tell the meaning and purpose of a map, and this done, proceed to draw in chalk, on the board, side by side with the model, an outline of the parts described in the lesson, calling upon the children to fill in all the names.

Summary of the Lesson

1. **An island** is land surrounded by water. A small island is called an **isle**. A very small island is an **islet.**

2. The larger land near an island is called the **mainland.**

3. **A peninsula** is land almost surrounded by water.

4. **An isthmus** is a narrow neck of land which joins a peninsula to the mainland.

A strait is a narrow passage of water between two pieces of land.

A channel is a wide and deep strait.

N.B. *The time of the next lesson should be devoted to a recapitulation of what has been taught, for the purpose of committing the above to memory, and the children themselves should be called upon (under the teacher's direction) to make models in clay and sand, representing islands, peninsulas, isthmuses, straits and channels, and also to draw plans of them on their slates.*

Lesson V

ROCKS AND SANDBANKS

Have in readiness the modelling tray with model No. 3 arranged, and the lower part of the tray modelled in sand and clay to represent the bottom of the sea. The toy ships will also be required. Brown's Picture, "Islands, Rocks, Roadstead, Harbour," for recapitulation.

I. Introduction

1. *Uncover the model, and as usual commence with a brief and rapid recapitulation of the subjects which have been already dealt with in the foregoing lessons.*

Call upon the children—

(a) To point out in the model examples of the various features—capes, islands, peninsulas, straits, bays, etc., as asked for by the teacher.

(b) To describe them one by one in their own way; and

(c) To give the formal definitions which have by this time been committed to memory.

2. *Call particular attention to the little inlet of the sea on the model, the narrow entrance to which is protected by a natural wall of rock and a* **breakwater.** *Elicit that this is* **a harbour,** *and that it provides* **a place of safety for ships** *in stormy weather.*

N.B.—*It should be borne in mind that this is a subject in which there can scarcely be too much, or too frequent recapitulation.*

Now that you know something about the land and the sea near it, I want to show you next what the bottom of the sea is like. Our model will tell us all we want to know.

II. Islands and Rocks

1. *Draw the upper tray carefully out of the frame, without disturbing the arrangement below it. This done, cover the top of each of the truncated portions with paper, cut to its shape to represent the level of the imaginary water, and on the paper build up, in sand or clay, representations of the parts removed. The edges of the paper will then represent the water-line.*

Point out that the whole model, as it now appears, shows us **what the bottom of the sea would look like,** *if all the water were drained out of it. Call upon the children to examine it carefully, and see what they can learn about it.*

2. *The first thing to strike them will most likely be that* **the sea-bottom,** *like the surface of the land,* **is made up of plains, hills,** *and* **valleys.** *Let them point these out in the model.*

Call attention to these **sea-hills,** *and notice that the tops of some of them rise up above the surface of the water, so that* **they have water all round them,** *and in this way elicit that what we call* **islands** *are only* **the tops of these hills in the sea,** *which show above the water's edge.*

3. *Tell that in some parts of the sea large clusters or* **groups**

of islands *are met with, and all of them are the tops of hills or rocks,* **which rise up from the bottom of the sea.**

A **group,** or **cluster of islands,** in the middle of the sea is called an **archipelago.**

Write the word in syllables on the black-board, and have it spelt in the usual way by the class.

4. *Notice next—*

(*a*) *That the tops of some of the sea-hills* **slope up gently from the sea,** *and are smooth and rounded.* These form **a sloping, sandy sea-shore.**

(*b*) *That the tops of others are* **steep, rugged rocks,** *which rise high out of the water.* These form **cliffs and headlands.**

(*c*) *That in other places again they do not rise high enough out of the water to form cliffs. Some of them* **just peep up through the water;** *others do not reach the surface*—**their tops are hidden below the water's edge.** These are **rocks, not islands.**

III. Sandbanks and Roads

1. *Call attention in the next place to the long, sloping ridge of sand which rises up from the sea-bottom to the surface of the water.*

It is **a long sea-hill made of sand** which the sea washes up, but it does not show above the surface of the water. We call it **a sandbank.**

Notice that it extends for a long distance almost parallel with the shore, so that there is **a deep valley between the shore and the sandbank itself.**

2. *Remind the children that, if this bank or hill in the sea were made of hard, solid rock, instead of sand, and rose up* **above the surface of the water,** *it would form* **an island;** *and then elicit that the passage of water between an island and the mainland is called* **a strait,** *or* **a channel.**

3. *Show that, although it is only made of sand reaching up to the water's edge, there is still* **a passage of water between it and the land.**

The passage, or channel of water **between a sandbank and the land** is called **a road,** or **a roadstead.**

Tell that, in stormy weather, when the waves are dashing about on the other side of the sandbank, **the water in the road is almost quiet,** *because the sandbank stands there like a great wall from the bottom of the sea, and* **keeps the waves back.**

4. *Lead the children from this to think of the purpose of a harbour.*

In stormy weather ships put into a harbour for safety, **because the storm cannot reach them there.**

Tell that, in the same way, **the roads or roadsteads** *provide* **a place of safety** *for ships, because* **the sandbanks prevent the great waves from rolling in.** *As they dash against the sandbank on the other side, they are broken up, and lose their force.*

IV. How Ships are Wrecked

1. *Replace the tray representing the sea now, with the islands and rocks in their original positions, and sprinkle a little sand on it to show the position of the sandbank below.*

Set one of the little ships on the imaginary water, and move it slowly on towards the harbour, **making it pass close by the sandbank and the half-hidden rocks.**

2. *Picture the real ships on the sea. Remind the children of the* **dangers of the terrible rocks.** *If a ship strikes on them, they tear a hole in its sides, the water rushes in, and it is soon* **broken up** *and* **dashed to pieces** *by the waves.*

The ship becomes a wreck and all the poor sailors perish.

Point out that the **sandbanks are as dangerous** *in their way as the rocks, for if a ship is driven on to a sandbank, it gets* **wedged in and held fast by the sand,**

and then **the waves dash over it** *and* **break it in pieces** *in a very short time.*

A shipwreck is a very awful and terrible thing.

3. *Tell that every ship carries its own charts or maps of the sea, and all the dangerous rocks and sandbanks are marked on those maps.*

If the sailors only know what part of the sea they are in, they can always find **from their maps** the exact position of these dangerous places, and then they can keep away from them.

How are they able to find their way on the sea? The sun guides them **in the daytime,** and the stars **at night.**

4. Then in the daylight, and on a bright, starry night they are quite safe, because they know where they are going. But think of them **in stormy weather,** and **in the darkness and fog,** when they have **neither sun nor stars to help them.** What is to happen to them then?

Tell that even in the worst of weather, the darkest of nights, or the densest fog, the poor sailors are not left helpless on the sea; that they have **a very wonderful instrument** *called a* **compass,** *which* **shows them the way to go,** *when they have nothing else to guide them.*

Promise the children that they shall learn all about this clever instrument soon.

Tell them too that, in the next lesson, we intend to show them how we take care of our sailors on the sea, and save them from being wrecked on those terrible rocks and sandbanks.

Summary of the Lesson

1. The bottom of the sea, like the surface of the land, is made up of plains, hills, and valleys.

2. The tops of the sea-hills, which show above the water's edge, form islands and rocks.

3. **An archipelago** is a cluster of islands in the midst of the sea.

4. **A sandbank** is a long sea-hill made of sand, which does not show above the surface of the water.

5. **A road or roadstead** is the passage or channel between a sandbank and the coast.

6. **A roadstead** provides a safe anchoring-place for ships during stormy weather.

7. A sandbank is as dangerous for ships as the rocks.

N.B.—*The time of the next lesson should be devoted to recapitulation as before, and the children should be called upon to make models in clay and sand, representing the sea-bottom, the coast, islands, rocks, and sandbanks.*

Lesson VI

DANGERS OF THE SEA

The teacher will require the modelling tray with the model arranged as in the last lesson, except that the lighthouses and light-ship will be fixed in their proper positions, so that they can be lighted up with the electric light the moment they are required. The toy ship and the model of the life-boat should also be in readiness, and a large inflated bladder and a bowl of water will be required. Brown's Pictures of the "Lighthouse," the "Light-Ship," "The Return of the Lifeboat," and the "Harbour," will be very useful in the lesson itself, and also for recapitulation purposes.

I. Introduction

1. *Uncover the model, taking care to keep the wires and the rest of the arrangements out of sight. The children will of course immediately recognise this as the model of their last lesson.*

Let them point out the various features represented in it—the **islands,** *the* **sandbank,** *the* **rocks,** *the* **little harbour** *with its sheltered entrance, and so on.*

What do we call this part of the sea between the sand-bank and the land? Why is it useful? How is it that ships can ride in safety there, even in stormy weather? Why is the sandbank itself dangerous for ships?

2. *Call upon the children now to look closely at the model, and see whether they can find anything in it which they did not notice when they saw it last; and in this way direct their attention to—*

(*a*) *The* **two tall towers**—*one at the mouth of the harbour, and the other on the rocks out at sea.*

(*b*) *The* **strange-looking ship** *floating above the sand-bank, with a sort of round cage at the top of its mast.*

Tell that the two towers are **lighthouses**; *that strange-looking ship is a* **light-ship**. *We are going to learn something about both now.*

II. The Lighthouse

1 *Lead the children to think of* **the street-lamps of a town,** *and proceed to elicit step by step—*

(*a*) That they are fixed on **tall lamp-posts** along the streets and roads, in order that they may shed their light in all directions.

(*b*) That when they are lighted after dark, **people are able to go about** as easily as they can in the broad day-light.

(*c*) That without these street-lamps we should not only **lose our way at night,** but we should always be **in danger of doing ourselves some injury in the dark.** We should be **afraid to move very far after dark,** if there were no lamps to light up the streets.

2. *Now picture the sailors on the sea. Their dangers are vastly greater than ours.*

Lead the children to tell that, on every coast there are not only **rocky headlands** *stretching out into the sea, but* **treacherous rocks and sandbanks** *in the sea itself, hidden perhaps beneath the waves.*

The lighthouses are the lamp-posts of the sea. They do for the sailor what our street-lamps do for us. They make it as easy for him **to sail his ship in the darkness of night** as it is in the daylight.

3. *Point to the lighthouse on the half-sunken rocks in the model.*

This one **warns the sailor of danger.** He sees it; he knows there are dangerous rocks there; **he steers his ship away from them**; and he is safe.

Lead the children to imagine what would happen if there were no lighthouse on dangerous rocks like these.

The ship as she sailed along would strike with a terrific crash on those awful rocks, and be dashed and broken to pieces.

4. *Now call attention to the other lighthouse at the entrance to the harbour.*

Point out that this, like the other, warns the sailors of the dangerous rocks; but at the same time **it shows the way to a place of safety** *inside the harbour.*

Now let us look at the lighthouse itself. It has to stand against the fury of the wind and waves in all weathers. It must be **very, very strong.**

5. *Notice that the tower is* **broad at the bottom,** *and narrower towards the top—that it is in shape* **like the trunk of some immense tree** *with its branches lopped off. Explain that, for strength to stand against the storm, this is found to be the best of all shapes.*

Tell too that lighthouses, and especially those on dangerous rocks out at sea, are built of the **very strongest and most durable kind of stone,** *and the foundations are always cut deep in the solid rock itself.*

6. *Call attention to the arrangement at the top of the tower. Tell that in a real lighthouse this is a large room, with* **thick glass all round it** *instead of a stone wall, like the rest of the building.*

It is called **the lantern,** and in it are **powerful lamps,** whose light can be seen for many miles. The lights from some lighthouses can be seen **at a distance of thirty miles across the sea.**

7. *Point out that as these lighthouses are placed all round the dangerous coasts, it is important that the sailors in the darkness should be able* **to tell one from another,** *or they would not know where they were. It is for this reason that* **the lights are not all alike.**

In one lighthouse **the lantern is fixed,** and it shows a bright light which **shines steadily all through the night,** like some very large brilliant star.

In another **the lantern moves slowly and regularly round,** and as it is made partly of glass and partly of wood, the light **first shows itself as a flash** through the glass, is next **hidden by the wooden shutter,** then **flashes out again,** and so on all night long.

8. *This talk about the lights will naturally rouse the curiosity of the children as to how they are lighted and kept burning night after night.*

Point out that there are **no lamp-lighters,** *such as we have in the town, to go round and light these lamps as evening comes on. Tell that men (generally two) are placed in charge of each lighthouse; that* **they live in the lighthouse;** *and that their duty is to* **light the lamps** *in the evening; to* **attend to them** *so that they burn well all night; and the next day* **to trim and clean them,** *in readiness for the coming night.*

9. *Tell that inside those solid stone walls of the tower there are rooms, one above the other, with steps leading up from them to the lantern at the top.* **These rooms are the home of the lighthouse-keepers.**

Picture the life of these brave men, shut up for weeks together in that lonely tower, with the winds howling round them, and the waves in stormy weather dashing up as high as the lantern itself.

Yet they are contented and happy, for they are doing good work. They are saving the lives of hundreds of poor sailors, who would be lost without their help.

III. The Light-Ship

1. *Call attention to the light-ship next. Notice where it is placed, and elicit from the children why a warning light is wanted near such a spot. Why put a light-ship there, and not a lighthouse?*

Tell that as **a lighthouse could not be built on these loose sands,** *a ship is placed there instead.*

Point out that this ship, like the lighthouse on the rocks, **has to brave all the fury of the storm,** *and, hence show that it must be* **very strongly built.**

Tell that **the round iron cage** *at the top of the mast serves very well as a warning in the daytime. The sailors see it, they know what it means, and they steer their ship away from the dangerous place.*

2. At night, when this signal could not be seen, the men in charge of the light-ship **hang a powerful lamp on the mast** just below it, and this serves to warn the sailors of their danger.

The children will naturally be curious to know how this ship can be kept in its place, while ordinary ships are dashed about by the waves.

Tell that **a heavy anchor is let down into the water** *at the end of a very strong iron chain;* **this anchor sinks so deep into the sand** *that, even in the most violent storm,* **the ship cannot be torn away** *from its place.*

3. *Now will come the interesting moment for the children. With everything in readiness, nothing more is needed but to connect the loose wires with the battery, and the lights will immediately flash out from all three positions.*

To complete the picture it would be well to move one of the little ships across the imaginary sea, to show how the lights enable them **to clear both the sandbank and the rocks,** *and at last* **enter the harbour in safety.**

IV. The Life-Boat

1. *Tell that, in spite of warning lights, ships are sometimes unable to battle with the fury of the storm, and then they are driven either on the treacherous sandbanks or the dangerous rocks, and wrecked.*

Picture the poor people struggling for life in the raging waters. What a cruel, awful death.

2. *Show the* **model of the life-boat,** *and describe briefly the principle of its construction by throwing the inflated bladder on the water.* **The bladder cannot be made to sink.**

The life-boat has large **air-tight chambers at the head and stern,** and others **all round the sides.** These air-tight chambers prevent it from sinking. **It will not sink,** even if it gets full of water and is crowded with people. It will even **right itself if it turns over.**

3. *Tell of the devoted bands of heroes all round our coasts, ready at a moment's notice to man the life-boat, and brave the dangers of the roughest sea, in the hope of saving some poor shipwrecked sufferers, who but for them must be swallowed up by the angry waves. Rough sailors they may look, but they are the bravest heroes, in spite of their rough appearance.*

Some one or other of the deeds of heroism, which are constantly being recorded, would form a fitting close to the lesson.

Summary of the Lesson

1. **Lighthouses** are placed on rocks, and on the dangerous parts of the coast, to warn sailors of their danger.

2. **Light-ships** are placed on the sandbanks, because a lighthouse could not be built there.

3. The light-ship is kept in its place by strong chains and anchors, which sink into the sandbank and hold it fast.

4. The lighthouses and light-ships are **the lamp-posts of the sea.**

5. **A life-boat** has air-tight chambers at the head and stern, and all round the sides. It cannot sink; it will right itself if it turns over.

Lesson VII

ABOUT MAGNETS

The following articles will be required for illustration: two or three knitting-needles, one of which has been magnetised as shown in the lesson, a few common sewing-needles, a flat cork, a basin of water, a magnetic toy-duck, a small horse-shoe magnet, and a bar-magnet; some iron filings; a magnetic needle on a stand.

I. Introduction

Some time ago I promised to tell you about the sailors' wonderful compass, which helps them to find their way in any direction on the sea, when they have nothing else to guide them. But before I can talk about the compass itself, I want you to watch, and try to understand, a few experiments.

II. Magnets draw Iron and Steel

1. *Fix a small sewing-needle on a flat piece of cork, and float it in a basin of water, side by side with one of the magnetic toy-ducks. Now bring one end of a magnetised knitting-needle near each of them, and let the children observe that* **the cork and the bird follow the knitting-needle** *wherever it leads.*

Repeat with an ordinary knitting-needle—one which has not been magnetised. **This has no power to move the things,** *even when we touch them with it.*

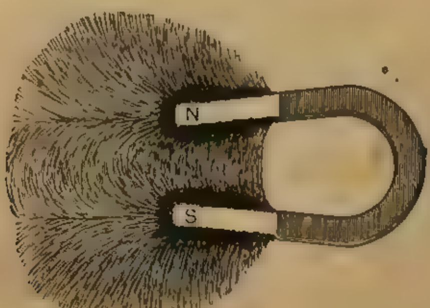
Repeat once more with **the horse-shoe magnet,** *and*

notice that the result is the same as with the first of the

knitting-needles. **The duck and the cork follow wherever it leads.**

2. The horse-shoe magnet is a very common toy with most children, although they probably know it by its more familiar name –**lōdestone.** *No doubt some of those in the class have watched it pick up pen-nibs, needles, small nails, and things of that sort.*

Tell its other name—**magnet**—*now, and explain that magnets have* **the power of drawing towards themselves things made of iron and steel.**



3. Illustrate this further (a) by holding the magnet over a saucer filled with iron filings, and (b) by plunging it bodily

into the filings. Then lead the children to tell, from what they have seen, why the magnet drew the cork and the toy-duck after it.

Bring one of the children to the front now, and let him repeat the experiment with the magnetised needle.

This knitting-needle you see again draws the cork and the bird after it, just as the magnet did.

What does that lead us to think? **The needle itself must be a magnet.**

4. Let us try again with the other one. Is that a magnet too? No; it is **not a magnet. It cannot draw the iron and steel** after it.

Suppose we make it into a magnet then.

Produce **the bar-magnet.** *Show that it acts exactly as the other magnet did when it is brought near the floating needle and the iron bill of the bird.*

Place the knitting-needle on the table, and stroke it carefully from one end to the other with the bar-magnet, **taking care to raise the magnet each time,** *so that* **there are no backward strokes.** *This must be repeated several times.*

If now either end of the needle be brought near the floating cork and the bill of the duck, these things will follow it as it moves about. We have made **this knitting-needle into a magnet,** *exactly like the other.*

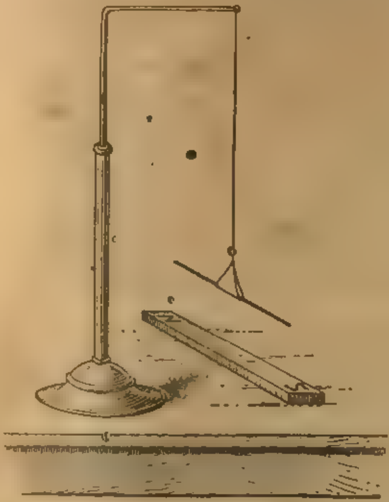
III. ONE MAGNET DRAWS ANOTHER

1. *Place the bar-magnet on the table now, and suspend the newly magnetised needle* **in a little loop of thin, light paper,** *by means of* **a silk thread,** *so that it hangs about three or four inches above it.*

Touch the needle gently so as to make it swing round, and watch it till it comes to rest. Observe that it then hangs **exactly in a line** *with the bar-magnet below it.*

Now move the bar-magnet slowly round into other positions,

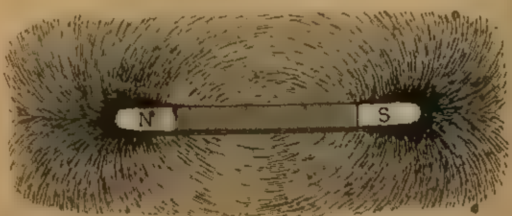
and show that, as it moves, **the needle swings round too,** *and each time comes to rest again exactly in a line with it.*



2. What do we learn from this? We learn that **the bar-magnet draws the needle-magnet** towards it.

But why should the ends of the needle always point to the ends of the bar-magnet? Perhaps we can find this out too.

Place the bar-magnet on a sheet of paper and sprinkle iron filings over it. Notice that the filings cling



in a thick bunch round each end, *and that there are very few in the middle of the bar.*

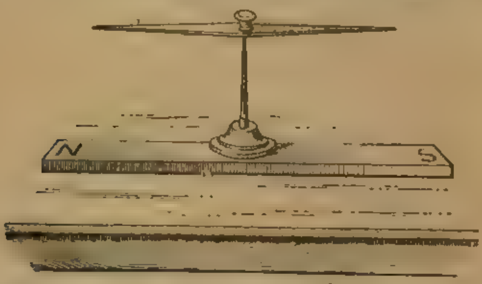
What would this lead us to think? That all parts of the magnet do not draw things with the same power. **The ends seem to have more power** to draw the iron filings towards them than the other parts have.

3. *Replace the bar-magnet now below the suspended needle.*

Watch the needle come to rest again, and explain that it always takes up this position in a line with the bar-magnet, because **all the strength of the bar-magnet is at its two ends.** *These two ends* **draw the two ends of the needle,** *and so make it point always in the same direction when it stops.*

Remove the suspended needle now, and in place of it produce **the magnetic needle on the stand.** *Set it on the table without saying anything about it for the present, but give the needle itself a slight touch with the finger, to show how easily it swings round on the steel point on which it rests.*

4. *Place the stand* **exactly in the middle of the bar-magnet** *now, as it lies on the table, set the needle swinging*



round again, and ask the children to watch it till it stops. Then explain as follows:—

This long, narrow, pointed piece of steel, you see, acts in exactly the same way as the knitting-needle did when we hung it up. It swings round and round for a time, and when at last it stops, **its two ends point to the two ends of the bar-magnet.**

5. *Explain that the knitting-needle would do the same if we could balance it on the steel point; but it would not be an easy matter to do that, and so we always use* **a flat piece of steel** *like this, instead of a needle.*

Show how it is made to balance on the pivot. Dip it into

the iron filings, and test it by bringing it near the floating cork and the duck, to show that like the needle **it is a magnet.**

Tell that although it is not at all like a needle in appearance, **we still call it a needle.** *Its proper name is* **the magnetic needle.**

IV. The Earth a Great Magnet

1. *Remove everything from the table now except the magnetic needle. Set the needle itself rotating, and call upon the children to watch it as before.*

When it has come to rest, notice the direction in which it points. One end of the needle is now pointing **to the north,** *the other* **to the south part of the room.**

Stick a piece of coloured paper on the end of the needle which points towards the north, and set it rotating once more. Observe that when it comes to rest again, **this end still points towards the north.**

2. *Move the stand round now into various positions, and test the needle again and again.*

Each time the needle stops, **the same end points in the same direction—north.** We must find out the reason for this.

How does the needle act when we place the bar-magnet under it? The two ends of the needle point in a line with the two ends of the bar-magnet.

Why? Because **all the strength of the bar-magnet is in its two ends.** One end of the magnet draws one end of the needle; the other draws the opposite end.

3. But there is no magnet on the table now to draw our needle. Why should it always point in this same direction—with **one end towards the north,** and **the other towards the south?**

Explain that **the earth itself is a great magnet,** *and that it draws the needle towards it—that like the bar-magnet*

all its strength is in its two ends, *which are in* **the north and south**—*and that this is the reason why the needle on the table* **always points in this one direction** *if left to itself.*

Summary of the Lesson

1. **Magnets** draw iron and steel towards them.
2. One magnet will draw another magnet towards itself.
3. All the strength of a magnet is in its two ends.
4. One end of the magnetic needle always points to the north, the other end to the south.
5. **Our earth is a great magnet.** All its strength is in its two ends—north and south. They draw the two ends of the needle towards them.

Lesson VIII

THE COMPASS

Provide for illustration: the magnetic needle, the school compass, and a small ship's compass if possible; and have in readiness three paper circles, one showing the four cardinal points, another showing those and the four intermediate ones—N.E., N.W., S.E., S.W., and another showing the whole thirty-two points. Brown's Picture of "The Man at the Wheel" should be provided for this lesson.

I. Introduction

1. *Commence by leading the children to tell the various ways we have of finding those four important points*—**north, south, east,** *and* **west.**

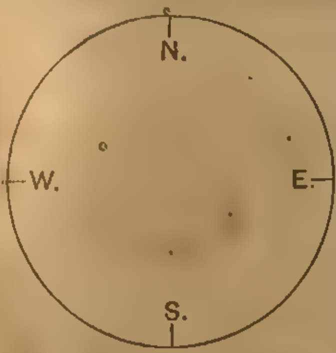
Elicit, by means of two or three minutes' practice, that it is only necessary **to know one of these points,** *and we can then easily find all the rest—that when* **we face the north** *we have the* **south behind us,** *the* **east on our right hand,** *and the* **west on our left.**

2. *Lead them next to think of the weathercock. Elicit that in*

foggy weather *this becomes quite useless,* **because we cannot see it;** *and then remind them that even* **the sun and stars are often hidden** *in like manner behind thick clouds, so that they can then give us no help.*

3. *Now place the magnetic needle on the table, and when it has settled, proceed to elicit, from what the children already know of it, that this would make a better guide than any of the others.* **Day and night, and in all weathers, this needle always points to the north.**

4. *Take the paper circle with the four points marked on it, and lay it on the table, placing the needle-stand in the centre of it.*



The needle itself, after oscillating to and fro, settles at last in the usual position **with one end pointing to the north.** *Show that in order to find the other points we must* **move the paper circle round** *till the letter N. marked on it points in the same direction as the north end of the needle.*

II. The School Compass

1. *As the school compass is usually constructed on this principle, it would be advisable to introduce it now. Show it and tell its name*—**a compass.**

Explain that the word **compass** *means* **a circle,** *and then (after first removing the needle) show that* **the bottom of the box is round** *or* **circular** *in form.*

Point out the four letters N. E. S. W. round the edge of this circular box, just like those round the edge of the paper circle on the table.

A mere glance at the other letters will be sufficient now. Promise to examine them later on.

2. *Call attention next to* **the small spike** *which stands up in the middle of the box. Produce* **the needle,** *and place it on the spike, and let the children see that when it comes to rest, one end of it, like one end of the other needle, points towards the north.* **It is a magnet, exactly like the other in every respect.**

Show that to find the other points we must now move the box round as we did the paper circle, till the letter N. on it **points in the same direction as the north end of the magnet.**

III. The Points of the Compass

1. What name do we give to the four points, **north, east, south, west?** We call them the **Four Cardinal Points.**

What does that mean? The **Four Principal Points.**

What do we learn from that? We learn that, as these are the **principal points,** there must be **other points** besides them.

Yes; there are other points. Let us see now what we can learn about them.

2. *Hand the box of the compass round the class, for the children to examine for themselves.*

There are so many points all round the circle, that I am afraid they would only puzzle you. Suppose we examine them a few at a time.

3. *Produce the card with the* **eight points** *marked on it.*

Show that **midway between N. and E.** *a new point is marked on this card, with the letters N.E. against it; and tell that* **N.E. means north-east.**

Call upon the children to point to the north and east sides of the room, and then midway between the two. Explain that this is the **north-east part of the room.**

Proceed to deal in a similar way with N.W., S.E., and S.W., and lay the card itself on the table to show the direction in which each points.

4. *It will be necessary to practise the children repeatedly in finding these eight directions, but* **they should not be called upon to learn any of the rest.**

It will be quite sufficient for them to know how these eight points are made into sixteen, and the sixteen into thirty-two, without attempting to learn their names.

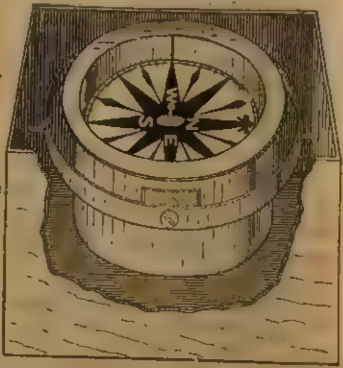
When that is done, let them count the number of points on the compass itself. **These thirty-two points** *are called* **the Points of the Compass; the four points N. E. S. W.** *are the principal ones, and they are called* **The Cardinal Points.**

IV. THE SHIP'S COMPASS

1. *Produce the paper circle on which the whole of the points are marked, fix it with gum or sealing-wax* **on the top of the magnetic needle** *with N. pointing to N., and show that when the needle moves round,* **it carries the paper circle round with it.**

Show the ship's compass now (if possible), and point out that in this there is **no needle to be seen.** *The card itself moves round just as our paper circle did,* **because it is fixed to the needle below it.**

2. *Tell that this is the kind of compass which sailors use at sea:*



It is sometimes called **the ship's compass,** and sometimes the **mariner's compass.** The word **mariner** is only another name for **a sailor.**

The other compass which we examined first is **a land compass.** The needle moves round by itself, and **the card is fixed at the bottom of the box.**

3. *Lead the children to tell again how people find their way with the land compass.*

They first **find the north** by noticing the direction in which the needle points, and then **they move the box round** till the N. on the bottom of the box is exactly under the north end of the needle. This gives them all the other points.

4. *Explain now very carefully how the ship's compass guides the sailors.*

The compass is **fixed on the deck of the ship**, so that **no part of it can move except the needle and the card which rests on it.**

It is always placed near the man who is steering, and on the top of the compass-box itself there is a very plain mark **in an exact line with the keel of the ship.**

If the man wants to steer the ship towards the west, he turns it round with the helm, **till the letter W. is in a line with the mark on the box.** He then knows his ship is going in the direction he wishes it to go.

5. *Explain briefly the great importance of the mariner's compass to the sailors on the sea. Remind the children that the sun and the stars can help them only in fine clear weather—that in foggy or cloudy weather, when the sailors cannot see the sun or the stars, they would be very likely to lose their way but for the compass, for they have nothing else to guide them.*

Tell that because of this sailors in the old times long ago never used to sail far away from the land; but now **no ship ever goes to sea without a compass,** *and the sailors* **can find their way** *with it wherever they may be, and* **in the darkest night** *as easily as in the daytime.*

Summary of the Lesson

1. The magnetic needle is the best of all guides, because it always points to the north, and then it is easy to find the other directions.

2. **A compass** is a round box, in the centre of which is a short spike, with a magnetic needle balanced on it.

3. The circle of the compass is divided into thirty-two equal parts. This gives us thirty-two points of direction. We call them **the points of the compass.**

4. The four chief points are north, south, east, west. We call these **the four cardinal points.**

5. In a land-compass the card, with compass-points marked on it, is fixed to the bottom of the box.

6. In a **mariner's compass** the card is fixed to the needle. We cannot see the needle itself. When the needle moves round it carries the card round with it.

7. The compass is always fixed to the ship, so that no part of it can move except the needle and the card which rests on it.

Lesson IX

MOUNTAINS AND TABLE-LANDS

The teacher should be provided with some damp sand, a large flower-pot, and either a very small cup, a wine-glass, an egg-cup, or a thimble for modelling purposes. The modelling tray with the prepared model of the mountain should be on the table covered up in readiness for the lesson. Brown's Pictures of the "Mountain Pass" and "Lauterbrunnen Valley" will be very useful.

I. Introduction

1. *Commence by leading the children to tell all they can remember of the nature of a hill. Elicit that—*

(*a*) A hill is a mass of land **rising high above the level country** round.

(*b*) The **bottom or foot** of the hill is called its **base**; the **top** its **crest** or **summit**; the **sides** the **slopes**.

(*c*) Most hills have **gentle slopes** and **smooth, rounded crests.**

2. *Illustrate this by reference to hills in the neighbourhood, and set one of the children to make a small sand model of a hill.*

Point out that from the summit of a hill we are able to look down on the housetops near. We find that we are **higher than the highest church steeple.**

3. *Tell that some hills are so high that* **a great many church steeples piled one above another** *would not reach to the top or summit of them.*

Those very high hills are called **mountains.** We might say **a hill is a very small mountain,** or **a mountain is a very large and high hill.**

Let the children compare the two in a simple way by moulding some damp sand in a thimble or an egg-cup, and a large flower-pot, and turning them out side by side.

To-day we are going to see what we can learn about mountains.

II. Mountains and Hills

Appearance.—1. *Explain, in the first place, that when we say a mountain is a very high hill we do not say enough.*

It cannot properly be called a mountain unless it is **upwards of 2000 feet high.** Below that height it is only a hill.

Explain, too, that the height of hills and mountains is always measured, not from the land at the foot, but **from the level of the sea,** *because the surface of the sea is like a level floor, and is* **the same in all parts of the world.**

2. When we say a mountain is 2000 feet high, we mean that, if **a great pole 2000 feet** in length could be set upright **on the surface of the sea,** the top of it (which would then be as high, say, as twenty church steeples one above the other) would **just reach the summit of that mountain.**

Tell that there are some mountains in the world **nearly 30,000 feet high**; *and explain that* 30,000 *feet measured in a straight line on the ground would reach* **between five and six miles.**

3. *Mention some place about this distance from the school, and lead the children to picture to themselves* **a pole of the same length set up on the sea-level.** *Ask them to try and compare this with the height of the church steeple, and also with a mountain* 2000 *feet high.*

4. The tops of these high mountains tower upwards to

such an enormous height that **they seem lost in the clouds.** We often speak of them as the **cloud-capped mountains**, because the clouds cover their heads or summits like a cap.

5. *Point out, in the next place, that mountains besides being higher than hills, are* **much more steep and rugged.**

The country all round the mountains is usually hilly, and the mountains themselves spring from this hilly ground. But it is easy to see from their appearance, without noticing the height, where the mountains begin, for instead of the smooth, sloping hill-side we find **huge masses of rock piled high, one above another,** with **deep clefts or chasms** between them. These make it very difficult to climb a mountain.

The snow-line.—1. *Tell that people who go up in a balloon always take thick coats and wraps with them, because* **the higher they go the colder they find the air** *all round them. If they took* **water** *with them in the car* **it would freeze,** *and at last, as they get higher still, it becomes so intensely cold that,* **the breath freezes as it leaves their mouth and nostrils.**

Remind the children that it is in those intensely cold regions of the air that **snow** *and* **hail** *are formed.*

Sometimes it is **the vapour of the clouds that is frozen,** and this forms snow.

Sometimes **the rain-drops freeze into round balls of ice** as they fall through the air, and they become hail.

2. *Tell that, in the same way, it is so cold on the tops of these high mountains, that they are* **covered with snow all the year round**—*summer as well as winter.*

Beyond a certain height we find **nothing but snow,** *for* **the snow never melts there.**

The line on the mountain-side where the snow begins is called **the snow-line.**

These white, snow-clad mountains towering up to the sky look **very grand, very wonderful,** and **very beautiful,** but many people lose their lives every year in trying to climb to the top of them.

Now will be the time to uncover the model, and spend a few minutes in recapitulating what has been taught, contrasting the mountain itself with the hills at its foot.

Ranges and Groups.—1. Mountains and hills usually occur in **a long row or line,** with their bases touching each other. We then call them **a range** of mountains, or **a chain** of mountains.

Lay a piece of chain in a line on the table to show what is meant, and point out that in a mountain chain each mountain may be looked upon as forming **one of the separate links.**

Sometimes the mountains, instead of extending in a line one after the other, **stand close together in a cluster.** We call them **a group of mountains.**

2. *Place a number of children of different heights first in a line along the room, and then in a cluster, to illustrate what is meant by the two terms.*

Notice as they stand together that one child here and there is much taller or higher than the rest. Tell that it is just so with the mountains, whether they are arranged in a chain or a group.

Here and there **some of the mountains tower up high above the rest,** and we call them **mountain peaks.** They are the highest mountains in the range or the group, and **each one is known by some special name.**

Mountain Valleys.—1. *Lead the children in the next place to tell that, whether the mountains occur in chains or groups, there must be* **hollows between them,** *and that the proper name for* **the hollow place between hills or mountains is a valley.**

Turn to the model once more, and call attention to the **wide, open valley** *stretching between the two mountains.*

Contrast this with the **deep, narrow cleft** *on the other side. Tell that this too is a hollow place between the sides of the mountains—it is* **a kind of valley,** *but because it is* **deep and narrow** *it is known as* **a mountain gorge,** *or* **a ravine.**

2. *Call attention to the bridge which crosses the ravine, and the narrow ledge leading from it along the side of the mountain. Tell that people who live in mountainous countries have to travel as well as they can across the mountains, and that this narrow ledge represents* **the dangerous roads, along which they travel.**

It is called **a mountain pass.** In many places these roads are only wide enough for one person to walk.

A glen is **a deep, narrow valley** between two mountains or hills, but unlike the ravine, it is **thickly wooded,** with trees on both sides.

III. Table-Lands

1. Let us leave the mountains and hills now, and think about the **low, flat land.** What name do we give to this? We call low, flat land **a plain.**

Explain that in some places the land is flat, but instead of being low like a plain it is **raised high above the level of the sea.**

Illustrate by reference to the floor and the table-top, and tell that those **high plains** *are called* **table-lands.**

2. *Turn now to the model mountain once more, and proceed to show what the actual table-land is like.* **A table-land is like a mountain with the top cut away.**

Point out that the land rises in every way **like the side of a mountain,** *but it is unlike the mountain, because it does not form a lofty peak.* **The top of this high land is flat**—*not of course smooth and level like the table; but there*

are **no jagged peaks** *rising from it, and therefore there are* **no valleys.**

A table-land is sometimes called **a plateau.**

Summary of the Lesson

1. **A mountain** is a very large and high hill. It must be 2,000 feet high to be called a mountain. Some mountains are nearly 30,000 feet high.

2. The height of hills and mountains is measured from the level of the sea.

3. Above **the snow-line** the mountains are covered with snow and ice all the year round.

4. **A range of mountains** or a **chain of mountains** is a long row or line of mountains.

5. **A group of mountains** is a cluster of mountains standing close together, but not in a line.

6. **A mountain peak** stands up high above all the other mountains in the range or group.

7. **A mountain valley** is a broad, open hollow between the mountains.

8. **A mountain gorge** or **ravine** is a sort of valley between the mountains, but it is deep and narrow.

9. **A mountain pass** is a road over a mountain.

10. **A glen** is a deep, narrow valley, thickly wooded with trees.

11. **A table-land** or **plateau** is flat land raised high above the level of the sea.

N.B.—*This lesson entails an unusual amount of memory work. The time, therefore, of the next lesson, and perhaps of the following one, would be well spent in recapitulation. The children as usual should illustrate their own answers by modelling in clay and sand.*

Lesson X

THE SNOW-CLAD MOUNTAINS

Articles for illustration: a lump of ice and a large bowl of water; some drawings of snow-flakes magnified, the modelling tray with the model of the glacier. Brown's Pictures of "A Glacier" and "Icebergs at Sea" will be required.

I. SNOW AND ICE

1. *Show a piece of ice. Observe that it is a* **hard, transparent, colourless solid,** *like a piece of glass. Compare it with snow, which is* **perfectly white, loose,** *and* **feathery.**

Lead the children to tell that snow is the **frozen water-vapour of the clouds.**

Explain that in the clouds this water-vapour is **mixed with air,** *and that when the vapour is frozen* **it is the air** *in it* **which gives it its white colour.**

2. *Show drawings of snow-flakes as they appear under the*

magnifying glass, and point out that they are all **six-sided figures.** *Each one is formed of* **six little ice needles.**

Lead the children now to think of their snow-balling games. Remind them that if they squeeze the snow very tightly in their hands, it becomes changed into ice.

N.B.—*It is needless to observe that if the weather conditions permit, this must be done, not described.*

Why is the snow changed into ice? In squeezing the snow **we press out all the air,** and cause the particles of ice to cling close together into a solid mass. **When the air is forced out, the white colour disappears.**

II. A Glacier

1. I want you now to think over our last lesson about the mountains.

If you were going up a mountain what sort of clothing would you put on? **Thick, warm clothing.**

Why? Because the higher we go up the mountain **the colder it becomes.**

What would you find there when you reached a certain height? **Snow.**

How do we describe that part of the mountain where we first find the snow? We call it **the snow-line.**

What do you understand by the snow-line? The snow-line marks that part of the mountain above which there is **snow all the year round.**

2. *Tell that it is so intensely cold on the tops of these mountains that* **snow falls very frequently and in immense quantities,** *and as the snow cannot melt, one layer is quickly covered up by another, so that* **every valley and ravine** *between the mountain peaks* **is filled up,** *and it looks like* **one immense field of snow.**

3. *Now remind the children of the snow-ball, and lead them to tell what must be the effect of the constantly increasing mass of snow on the layers underneath.*

The weight of the mass above **presses heavily** on that which is below, and **forces all the air out of it,** and so changes it from snow into solid ice. **Instead of fields of snow they become fields of ice.**

4. *Point out next that all these mountain valleys of course slope downwards; and that the pressure of the constantly falling snow is always increasing from above, and in this way elicit from the class that* **the mass of ice must be forced down the slope** *little by little.*

The fields of ice **become rivers of ice,** for they actually move down the mountain slopes. **These rivers of ice are called glaciers.**

5. *Explain that as the glacier slides down the slope, the lower part of it reaches warmer regions, and* **then it begins to melt.**

The water from the melting ice flows down the sides of the valley, and **this helps the glacier to slide more easily.**

Tell that **the glacier** *after all* **moves very slowly**—*never more than* **one or two feet in the day,** *often not more than* **a few inches.**

6. *Show the model now, and let the children examine it carefully.*

Call attention to the water which flows from the lowest part of it.

This is the **water from the melted ice.** What becomes of it?

Tell that this, like all other water which flows down from the hills and mountains, forms a river. **Melting glaciers form the sources of many rivers.**

III. An Avalanche

1. *Remind the children that after a heavy snow-storm, we*

often see, when the thaw sets in, the whole mass of snow slide down from the roof of a house.

Picture the same thing taking place on the side of the mountain, but on such an immense scale that the mass of falling snow is enough to overwhelm a whole village in the valley below.

2. The snow, as it is forced onwards by the pressure from above, moves easily enough down the sloping sides of the mountain, till it comes to some part steeper than the rest, and then **it falls with a rush, and a roar like thunder,** into the valley below.

A mass of falling snow like this on the mountain-side is called **an Avalanche.**

Tell of the dangers of the avalanche to travellers crossing the mountains.

IV. An Iceberg

1. *Produce the piece of ice, and let one of the children put it into a vessel of water—a tall glass vessel of some sort would be best if it could be obtained.*

What do you observe? **The ice floats** on the top of the water.

Push it down. What happens when it is left to itself? **It flies up** and **floats on the top** again **like a cork.**

What do we learn from this? We learn that **ice is lighter than water,** because it floats.

2. *Now show the picture of the iceberg. The first thing to surprise the children will be the ship. They will see from this that we have left the snow-clad mountains, the glaciers and avalanches, and are on the sea again.*

What is that great, green, glittering mass towering above the ship?

Tell that it is **a great mass of ice** *floating in the sea. It is so big that we call it* **an ice mountain.** *It is a* **floating mountain of ice.**

Its proper name is **an Iceberg**—the word "**berg**" means "**mountain.**"

3. In some parts of the sea sailors meet with **hundreds of these great floating ice mountains.** Let us see what they are, where they came from, and why they are found floating in the sea.

Tell that they are simply **pieces chipped off,** *or* **broken off from some enormous glacier,** *which moved slowly down some mountain slope, and at last toppled over into the sea.*

4. The glaciers from which these icebergs come are always formed in the **cold, frozen regions of the world,** where there is **ice and snow** not only on the mountain-tops, but **everywhere.**

When the great mass of ice falls into the water, it floats away out to sea.

Think of it as it floats about in the water till it comes to some warmer part of the world.

What would be likely to happen then? **The ice would melt away.**

5. *Explain that this is exactly what does happen. Turn to the picture once more, and call special attention to the* **ragged appearance of the iceberg.**

This one is **melting little by little.** After a time these great overhanging masses break away and fall into the sea, and so by degrees **the whole of the iceberg disappears.**

Tell how dangerous the icebergs are to ships on the sea, and how careful the sailors are to keep out of their way if they can.

6. *Call attention once more to the lump of ice floating in the water. Point out that the part below the water is much greater than the part above the surface. Explain that it is exactly the same with the iceberg.*

The great mass of ice may tower hundreds of feet above the surface of the sea, but **the part below the water is many times greater than the part above.**

SUMMARY OF THE LESSON

1. **A Glacier** is a river of ice which moves slowly down the side of a mountain. It is formed from the snow that falls on the mountain.

2. That part of the glacier which is below the snow-line is always melting. The water from the melting ice of glaciers forms the sources of many rivers.

3. **An Avalanche** is a mass of snow falling down the side of the mountain.

4. **An Iceberg** is a mountain of ice floating in the sea. It is only a piece chipped off some great glacier. It floats because ice is lighter than water.

Lesson XI

MOUNTAINS WHICH BLAZE AND SMOKE

Have the modelling tray in readiness, with the volcano and the geyser prepared and arranged in accordance with the instructions given, so that when the time comes, each may be made to work as required. Provide also specimens of lava and pumice-stone for inspection during the lesson, and some small pieces of cork for the basin of the geyser, and to represent the masses of rock which are hurled up from the crater of the volcano. Brown's Pictures of "A Volcano Eruption" and "A Geyser" will be useful for recapitulation.

I. APPEARANCE OF THE MOUNTAIN

1. *UNCOVER the model, and at once proceed to call attention to the mountain, without saying anything for the present as to the name—volcano.*

Notice that, unlike most other mountains, this one **does not form part of a range or a group,** *but seems to rise up directly from the level country round, and* **stand there alone.**

Notice next its peculiar shape. It has **no jagged, rocky peaks** towering up to the sky, with broad valleys and deep ravines between them, but its sides and top have a **smooth, rounded appearance.** It looks **like a cone** or a sugar-loaf **with the top cut off.**

In illustration of what is meant show the cone used in the

drawing lessons, or better still (if possible) show one that has been truncated.

2. *Turn once more to the model, and point out in the next place that the top of the mountain is not flat.*

It is **hollowed out in the form of a basin,** and this hollow, basin-like cavity is known as **the crater** of the mountain.

Explain that in some of the actual mountains **the crater is several miles across,** *and of immense depth, and* **the sides of the huge basin** *all round are formed of* **steep, lofty, rugged rocks.**

N.B. *The teacher should, at this point, light the free lower end of the fuse, from behind the model; and he should take care to do this without letting the children see what is going on, or it will spoil the illusion.*

3. *Notice the thin curl of smoke which now rises from the crater.*

Tell that the strangest thing about these mountains is, that there is almost always either **flame and smoke,** *or else a* **dense volume of steam,** *pouring out from the crater: and travellers who climb the mountain-side to see what the crater is like, find the* **ground beneath their feet quite hot,** *as though the inside of the mountain itself were on fire.*

These mountains are actually on fire inside. We call them **volcanoes.**

Some volcanoes are **always smoking** night and day. **Others are quiet for a time,** and nothing is to be seen, perhaps for many years, but some steam rising from the crater, like the steam from a railway engine, till all of a sudden they break out with a fearful explosion, and we say there is **an eruption.**

II. The Volcano in Action

1. *Tell that some days before an eruption takes place,* **low rumbling sounds are heard** *deep down in the earth, the whole mountain seems to* **tremble and shake,** *and steam pours out from the crater in huge puffs.*

Then without a moment's warning **an awful explosion**

takes place; dense volumes of **flame and smoke** *burst out from the crater; huge masses of* **rock, stones, cinders,** *and* **ashes** *are hurled up miles high into the air; and streams of* **boiling, melted rock, or lava,** *flow down the mountain-sides, and spread themselves over the country for miles round, scorching and burning up everything they touch.*

N.B. *With a little care the teacher can so time his description, as to bring about his mimic eruption at this very point, and the children will see for themselves the flames, smoke, and upheaval, and eventually the lava flowing down the mountain-side.*

2. *Picture the sky lighted up with the lurid flames, and at the same time darkened for miles round with the* **dense clouds of ashes and fine dust,** *which for days and weeks after the eruption settle on everything like a black pall.*

This gradual fall of rock, stones, cinders, ashes, and dust explains **why the volcano is always cone-shaped.**

The heavier masses of rock and stone which are hurled upwards into the air either fall back again into the fiery furnace whence they came, or else roll down the slope of the mountain; but the smaller stones, cinders, and ashes as they fall **are piled up in circular layers** all round the actual cone. **The cone itself grows larger** in fact after each eruption.

3. *Show a specimen of lava, and let the children examine it for themselves. Tell that this lava was formed from rocks deep down in the earth.* **The rock was melted by the intense heat** *inside some volcano, and in its molten state it flowed down the mountain-side and over the land near,* **like a river of boiling pitch.** *It was many years before it cooled and became solid again as we see it now.*

N.B.—*The lava stream, as it flows along, cools very rapidly on the surface, for in a few days after the eruption it is hard enough to walk upon. But years afterwards, if an iron spike is driven into it, the inside is found to be very hot still, and clouds of steam pour out from it, although the outer surface may be quite cold.*

4. *Hand some pieces of* **pumice-stone** *round the class next for inspection, and lead the children to tell from their own observation—*

(*a*) That it is a **hard, brittle substance,** for it breaks with the blow of a hammer; and

(*b*) That it is **very light and spongy-looking.** Some kinds are so light that they **float in water.**

5. *Tell that as the black, boiling river of lava flows along,* **patches of loose, frothy scum** *rise to the surface and float there, because they are lighter than the liquid lava itself. This light, frothy scum is the first to cool, and* **when cool it is known as pumice-stone.**

Call attention to the holes in a piece of bread. Point out that these were formed by the steam from the moist dough during the baking, and show the parallel in the case of the pumice-stone.

This substance, as well as the lava itself, in the molten state, deep down in the earth, was **full of steam and other vapours,** and as it cooled these vapours formed the little holes which we see in it.

III. Volcanic Islands

Tell that sometimes a volcano is formed in the bed of the sea. Picture an eruption from such a volcano.

What must become of all the rock, stones, cinders, ashes, and lava from it? It must all sink down through the water again, and **form a piled-up heap there,** and this would in time **become a mountain in the sea,** because it would get bigger and bigger after every eruption.

When a mountain in the sea peeps up above the surface of the water, what do we call it? **An island.**

This explains how new islands are constantly forming in the sea. They are **formed by volcanoes** under the sea, and we call them **volcanic islands.**

IV. A Geyser

Tell that in some parts of the world, in place of volcanoes with their flames, smoke, ashes, and molten rock or lava, **boiling springs** *are found.*

These boiling springs are called **geysers.** They send up **jets of boiling water and steam** to the height of a hundred, and often a hundred and fifty feet.

Just before the water bursts up from the earth, **low, distant, underground rumblings** are heard, like those which give warning of an eruption of a volcano, and the ground all round **shakes and trembles violently.**

Then there is usually **a loud explosion,** and the steaming hot water mounts upwards **like a jet from some immense fountain,** carrying stones and great pieces of rock up with it.

Show this in the model with pieces of cork substituted for the rock and stone.

V. How they are Formed

N.B.—*Some explanation of these phenomena will be necessary at this stage, but the teacher must bear in mind the capacity of these young children and the scope of the previous teaching.*

1. *Remind them that we have already spoken of the sun as a great ball of fire, and explain that ages ago* **this earth** *on which we live* **was a burning mass like the sun.** *Since then it has been cooling little by little, but like the lava from the volcano it is only the outside which has cooled.* **The inside of the earth is still very hot.**

2. It is the **intense** heat deep down in the inside of the earth which produces not only the **flames and smoke and lava** of the volcano, but also the **boiling water** of the geyser.

Remind them too of the bladder of air held in front of the

fire, and lead them to tell that the heat of the fire made the air inside the bladder swell up, so that it wanted more room (Stage I., Lesson VIII.).

Tell that heat causes not only air but almost everything to swell up, and explain that the **hot vapours and steam** *inside the earth* **swell up** *with so much force that they* **burst holes in the earth itself,** *to form these volcanoes and geysers, and hurl great masses of rock and stone miles high into the air.*

Summary of the Lesson

1. **A volcano** is a mountain, which throws out smoke, flames, ashes, cinders, and lava.

2. **The volcano** is usually a cone-shaped mountain.

3. In its summit there is a deep hole—**the crater**—which is often several miles across.

4. **The crater** is the chimney out of which the smoke, flames, ashes, etc., are poured.

5. **Pumice-stone** is the hardened scum which floats on the top of the boiling lava, as it flows down the mountain-side.

6. **Volcanic islands** are formed by volcanoes in the bed of the sea. These volcanoes throw up such heaps of rock, stone, ashes, and lava that they form a sea-hill, which at last peeps above the water, and forms an island.

7. **Geysers** are boiling springs which spurt up out of the ground sometimes to the height of 100 feet and more.

N.B.—*The usual recapitulation should follow.*

Lesson XII

RIVERS (First Lesson)

Have in readiness the modelling tray, with the model of the upper reaches of a river and its feeders properly arranged. A large sponge, a board or rough tray of some kind, some clay and sand, and Brown's Pictures of "A River" and "The Falls of Niagara" will also be required.

I. INTRODUCTION

1. *UNCOVER the model, and commence by leading the children to tell all they can of the nature of a river, so far as it has been dealt with in the earlier lessons. They will have no difficulty in telling—*

(*a*) That a river is **a running stream of fresh water**;

(*b*) That it is **fed by springs**, and **by the rain** which falls on the sloping sides of hills and mountains;

(*c*) That **it flows downwards**, because it is always seeking the lowest level;

(*d*) That, as it flows, it receives the waters from other smaller streams, which are called its **feeders** or **tributaries**;

(*e*) That **it grows broader and larger** continually; and

(*f*) That it at last **loses itself in another river or the sea.**

2. *The nature of the source of the river may now be further illustrated as follows:—*

Soak a sponge thoroughly in water, and stand it on a small board, or a slate placed in a sloping position. Let the children observe that, after a while, the water trickles very slowly indeed from the sponge. **The sponge holds the water.** *Now pour some more water on the sponge from time to time, and point out that, as this is done, there is* **a constant stream flowing down the slate.**

Tell that the earth acts very much like the sponge in this respect. **The spongy ground holds the rain** *as it sinks in, and only lets it flow out gradually.*

In this way **the water from one shower of rain** is sufficient to keep the spring running, **till the next shower comes.**

3. Some rivers are fed without any springs whatever,

with water which flows direct **from marshy, spongy land.**

Remind the children too of the snow-clad mountains and their glaciers, and lead them to tell that some rivers are formed and fed by **the water from the melting ice of the glaciers**; *these rivers have no springs at their sources.*

II. WATERSHEDS

1. *Call the attention of the children to the rain which falls on the roof of a house.*

It runs **down both the sloping sides** *into the gutter at the edge of the roof.*

Show that the top ridge of the roof **separates** *or* **parts the rain** *as it falls, and makes it flow in these different directions,* **because water cannot flow up.**

2. *Point out that we may notice* **the same kind of thing in the roadway** *after a heavy shower, and lead the children to tell from their own observation—*

(*a*) That the roadway is always **highest in the middle,** and slopes down towards the gutter on either side.

(*b*) That the rain which falls on this high part **runs away in little streams,** some down one slope, and some down the other.

(*c*) That as these little streams flow down, **they run one into another** and make larger streams, which flow at last into the gutter at the side of the roadway.

3. *Point out that the middle of the roadway, like the ridge of the roof,* **parts** *or* **separates the water,** *and makes it flow in these two directions.*

Apply this to the rain falling on hills and mountains, or the water flowing from the melting glaciers, and the children will have no difficulty in grasping the rest.

4. Wherever water falls it must flow in streams **down the sloping ground.**

Hills and mountains therefore **separate,** or **part,** or **shed these streams,** and **make them flow in different directions.** High ground of any sort must do the same, and we call it a **Water-parting** or a **Watershed.**

Call upon the children now to give examples of watersheds in the model before the class.

III. River-Basin

1. *This last exercise should naturally prepare the way for the next step. Turn once more to the model, and point out that the country, through which this river and its tributaries flow,* **is shut in by high land on almost all sides,** *and that the streams all flow down the different slopes to join the main stream.*

Compare the ridges of this high land all round to the **edge or rim of a saucer or a basin,** *and tell that the whole of the land enclosed by this high ridge is called* **the Basin of the river,** *or the* **River-basin.**

2. *Remind the children once more that all the rain which falls on this side of the high ridge* **must flow down the slopes in streams,** *either directly, or from springs, and so it finds its way into the main stream, and is carried out to the sea.*

Hence the rain, instead of lying where it falls to make the land a useless swamp, is carried away to the sea. We say that the river and its tributaries **drain the land;** and the name **river-basin** is given to all **the land which the river and its tributaries drain.**

IV. The Banks of a River

1. *Refer to the model once more, and call attention in the next place to the land on either side of the stream.*

We call the land by the side of the river **the river bank,** and of course **every river has two banks.**

They are known as the **right** and **left bank,** according as they are on the **right** or **left** of a person who stands **with his back to the source.**

Call upon the children to point out the right and left banks of some of the streams in the model.

2. *Picture the river at its source among the hills*—**a mere thread of water** *rippling over its pebbly bed—a boy could easily jump from one bank to the other. Follow it in its course down the sloping ground,* **always increasing in width and depth, always seeking a lower level.**

What kind of stream would you expect it to be? **A very swift-flowing stream.**

V. Waterfalls

1. *Tell that on its way the river may often come to places where there is* **a more rapid fall in the ground** *than usual. This only helps it in its onward course,* **for the water dashes over the rocky ledge,** *falls foaming to the lower level, and then flows on more swiftly than before.*

We call the place, **where the river leaps over a ledge of rocks** in this way, **a waterfall or a cataract.**

2. *Tell of the mighty* **Falls of Niagara,** *where a great river leaps over a ledge of rocks* **more than 150 feet high,** *and falls to the bottom* **with a noise like thunder,** *filling the air all round with clouds of spray.*

The rivers in our land have no great waterfalls like this, but there are many small ones. **A small waterfall** is sometimes called **a cascade.**

3. *Lead the children step by step to deduce for themselves—*

(*a*) That waterfalls can occur **only in hilly and mountainous places.**

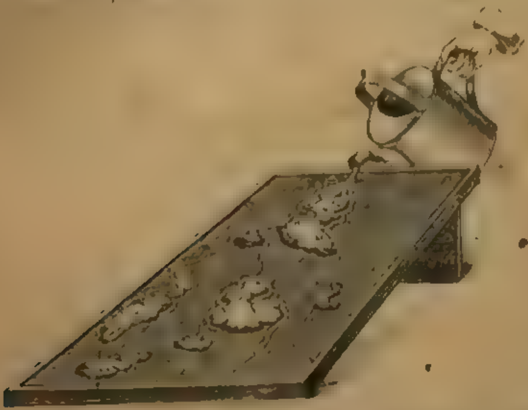
(*b*) That when the river reaches the low plains, it is no longer a rapid stream, but **creeps along slowly.**

Illustrate this by pouring some water on a slate first in a sloping position and afterwards held level.

VI. Why Rivers Wind about

1. *Direct the attention of the children once more to the little streams of water which they see in the roadway after a heavy shower, and lead them to tell*—

(*a*) That although these streams all flow down the



sides of the road towards the gutter, **they do not flow in straight lines.**

(*b*) That every stone—every rough place in the road of any sort—**turns them out of their course,** and makes them **wind about** in different directions.

2. *Illustrate further as follows: Place a few pieces of clay here and there on a board, and then spread sand over the other part, so as to cover it to the depth of about half an inch. Let the board be now placed in a slightly tilted position, and pour*

water gently on the higher part of it, calling upon the children to observe what takes place.

The little stream of water flows down the sloping board in a straight line, till it meets with the clay, and **it then turns aside and flows in another direction.** It can wash a passage for itself through the loose sand, but it cannot do so with the clay, and so **it has to flow round it.**

3. *Notice that this occurs again and again, as the stream meets with other pieces of the clay.*

Explain that it is exactly the same with a river:—

The river makes its own bed or channel as it flows along.

It can only do this **by washing away the earth.**

When the water meets with any material which it cannot wash away, **it flows round it.**

Summary of the Lesson

1. **A river** is a stream of fresh water, which runs over the land, and loses itself at last in the sea, or in another river.

2. **The source of a river** is its beginning.

3. **The tributaries** or **feeders** of a river are the small streams which flow into it.

4. **A river-basin** is the land from which a river and its tributaries get all their water.

5. The river and its tributaries drain this land.

6. **A watershed or water-parting** is the high ground which separates two river-basins.

7. **The banks** of a river are its sides.

8. The right and left banks of a river are on the right and left of a person who stands with his back to the source.

9. **Waterfalls or cataracts** are formed when a river dashes over rocks.

10. A small waterfall is called a **cascade.**

N.B.—*This lesson as usual should be followed by one devoted to the work of recapitulation and modelling in clay and sand by the children.*

Lesson XIII

RIVERS (Second Lesson)

Provide for illustration: some sand, clay, garden-mould, and pebbles (large and small); a large glass bowl of water, and a beaker, or a common tumbler. The modelling tray, with the model of the lower reaches and mouth of the river properly arranged, should also be in readiness. The teacher will prepare the delta with sand and clay as the lesson proceeds.

I. The Flow of the River

1. *Commence by referring once more to the appearance of the roadways after the rain. Point out that, when it has been raining very heavily, we often see quite a wide stream of water rushing along the gutter at the side of the road.*

Ask the children, when they next see such a stream, to throw into it some little pieces of cork or paper, and observe what happens.

The pieces in the middle of the stream will **float along very quickly,** and soon leave behind those that **are near the sides.**

2. Why do the pieces of cork and paper move at all? They are **carried along by the water** as it flows.

Then as some of them move more quickly than others, what must we think? The water in the **middle of the stream must flow faster** than that at the sides.

Tell that this is quite true, and that it is as true of the river and other streams, as it is of the stream of water in the gutter.

3. *Lead the children, step by step, to deduce the reason for this.*

The water at the sides of the stream **washes and**

presses against the solid earth of the banks as it flows along; it would spread out beyond the banks if it could, but they keep it back. It is the struggle between the water and the banks, which **delays the flow of the stream at its sides**; but there is nothing in the middle of the stream to prevent the flow of the water.

4. *It would be better of course if a suitable day could be chosen for this lesson, so that the children might observe for themselves, instead of being told. It would be better still, where the locality permits, to take the children to an actual stream for observation.*

Point out, and show by the same reasoning, **why the flow is always faster on the outer,** *than on the inner bend of a winding river.*

II. The River-Bed

1. *Pass on next to consider* **the state of the road itself,** *after the rain has all cleared away. Lead the children to tell from their own observation how, in some places, the streams made by the heavy rain* **tear up the road into grooves and channels,** *and* **wash the mud, sand, and pebbles** *away to a distance.*

Tell that this observation of the road after the rain will help us to understand many things about **the bed of the river—the groove or channel in which the river flows** *for the flowing water of every stream and every river* **tears up its bed,** *and* **washes away mud, sand, and stones** *to a distance, just as the rain-streams do in the roadway.*

2. *The following experiments will make this all very clear:—*

Put a lump of salt in a tumbler of water, and stir it up till it disappears.

Elicit that **the salt dissolves**; *that it is all in the water although we cannot see it; that we can easily detect it* **by tasting a drop of the water.**

3. *Now put some earth into the water, and stir it up in the same way, calling upon the children to tell what they observe.*

The **earth begins to break up** in the water, but **it does not disappear.** It gives the water a muddy appearance. We can see the little particles floating about in the water.

Tell that, because **the little particles of mud float about** *like this, we say they are* **suspended**; *and that if the tumbler is allowed to stand,* **the mud will, after a time, sink to the bottom.** *Stand it aside for examination later on.*

4. *Now fill a large glass bowl with water, and pour some sand into it.*

Elicit that **the sand is neither dissolved nor suspended**; *that it all sinks to the bottom at once and lies there.*

Then show that, by gently stirring the water, the sand is little by little whirled up, and carried round and round.

The particles of sand **float** and **are suspended so long as the water is moving,** but as soon as it ceases to move the sand begins to sink.

5. *Lastly, put some pebbles, large and small, into the bowl with the sand, and stir the water as before.*

Call upon the children to observe that, the sand as before rises and moves with the moving water, but the pebbles still remain at the bottom.

Show that it **requires much more vigorous stirring to move these stones,** *but that at last the moving water is able to move them too, and they are carried along with the particles of sand.*

For the time being **the pebbles are suspended in the water like the sand.**

6. *Now suddenly stop stirring the water, and call upon the children to observe what happens.*

The pebbles **at once sink to the bottom**—the largest

ones first, and then the smaller ones—and as the water begins to move more and more slowly, **the sand also sinks.**

7. Now let us see what we learn from all this. We know that the river, as it flows along, carries with it mud, sand, and stones, **which it washes out of its bed.**

We have learned, too, that the water **flows faster in mid-stream** than at the sides.

8. Now think of what our experiments have shown us, and then try to answer the following questions:—

Why is **the river-bed always deepest in the middle,** and shallower and shallower as we approach the banks?

Why do we find in one place **a pebbly bottom,** in another **a sandbank,** in another **mud,** in another **deep, hollow pools,** and so on?

9. *It will be an easy matter to bring this all clearly home to the children now, and to show them:—*

(*a*) *That in the* **swiftly-flowing parts** *of the stream we find* **a pebbly bottom;**

(*b*) *That* **where the flow is more gentle** *there is* **a bed of sand;** *and*

(*c*) *That* **where the stream moves sluggishly, mud takes the place of sand.**

10. *Point out in connection with this that the tributaries of a river have, as a rule, a much swifter flow than the river itself. Show the reason for this.*

Tell that where this is the case, there is usually **a sand-bank** *or* **a little island at the confluence**—*the spot where the tributary runs into the main river. Show this in the model, and explain the reason for it as follows:—*

The swiftly-flowing stream is able to carry away a large amount of sand in its course; but when it

meets with the slower moving water of the river, it is **suddenly made to move slowly itself**, and then the sand which was suspended in its water **must fall**, just as ours did in the bowl.

III. The Mouth of the River

1. *Elicit next that the part of the river where it joins the sea is called its mouth.*

Remind the children that throughout the whole of its course the river gradually widens. Beginning as a mere thread of water, over which a boy could jump with ease, it becomes at last a wide stream, with ships, perhaps, of all sizes on its waters coming and going continually.

Some rivers are many many miles across at their mouths.

2. **An Estuary.**—*Show the estuary in the model now.*

Point out that this is the **wide mouth of a river.** *It is so wide that* **the sea runs a long way up it at every high tide,** *so that for miles up the river the salt water of the sea mingles with the fresh water which is flowing down.*

We call **a wide river-mouth** of this kind **an estuary**; and because **the tide flows up it** in this way, we call the river itself **a tidal river.**

Remind the children of the wearing-work of the tide on the sea-coast, and point out that the same work is going on along the banks of the estuary, so that **the tidal waves and the flowing stream** *of the river together are continually* **making the mouth wider and wider.**

3. **A Delta.**—*Refer once more to the islands and sandbanks which are sometimes formed at the confluence of the tributary with the main river, and then prepare and show the model of the delta.*

Tell that this represents a river-mouth of another kind. Point out that there is **no wide estuary here,** *but instead*

of that **the river enters the sea by a number of separate mouths.**

Elicit that **the land between these mouths forms a number of islands,** *for the water is all round them.*

4. *Call attention to the peculiar way in which these mouths enter the sea. They have something of* **the shape of an open fan.**

This land at the mouth of a river is known as a **delta,** because in shape it is very much like the Greek letter—delta—Δ.

5. *Explain that the delta is formed in much the same way as the sandbanks and islands are formed at the confluence of the tributary with the main stream.*

The river-bed becomes less and less sloping, or in other words, **more and more level,** as it approaches the sea, and so **the flow of the water becomes slower and slower.** This slowly moving water cannot hold the mud and other matter suspended; hence **it all sinks to the bottom** and forms a deposit there, and this in time **rises higher and higher,** till at last **an island is formed at the river-mouth.**

Summary of the Lesson

1. The middle of the stream flows faster than the sides.

2. The outer bend of a winding river flows faster than the inner bend.

3. **The bed of a river** is the groove or channel in which the river flows.

4. The river, as it flows, tears up its bed, and carries away mud, sand, and stones to a distance.

5. The swifter the river, the more sand, stones, and other materials will it carry away.

6. **The confluence** of a tributary is the place where it joins the main river.

7. **The mouth of a river** is the end of it where it loses itself in the sea.

8. **An estuary** is a very wide river-mouth, up which the tide of the sea flows.

9. **A tidal river** is a river with a long, wide estuary. It is so called because the tide is felt a long way up the river.

10. **A delta** is the land between the mouths of a river. It is formed by mud, sand, and other material washed down by the river.

N.B.—*The usual lesson for recapitulation and memory work, and modelling in clay and sand should follow this.*

Lesson XIV

RIVERS AND LAKES

Prepare and have in readiness the model of a lake, with streams running into and out of it. Brown's Picture of the same lake would be found useful for the purpose of recapitulation later on.

I. Roadside Pools

Make a rainy day once more the starting-point of the lesson. Lead the children to tell from their own observation that after the rain is over they see, besides the streams of water flowing down the gutter, **puddles of standing** *or* **still water** *in the road itself; and that they know the puddles are still water, because pieces of cork and paper thrown into them do not move.*

1. *Elicit step by step*—

(*a*) That these puddles are always met with **where the ground is uneven**;

(*b*) That they are **fed by little streams** formed from the rain;

(*c*) That, as water must flow down, **the streams run into these hollow places** in the ground, and **fill them up**; and

(*d*) That the water is held in there, and cannot flow away, **till the puddle itself becomes full and overflows.**

2. *Point out that when this happens* **a stream flows out of the puddle,** *because water will always try to reach the lowest level.*

In this way it will be easy to demonstrate that, although the puddle itself is still water, **it is fed by running streams,** *and that there are* **other streams flowing out of it.**

In some places, owing to the nature of the ground, the rain-puddles spread out into **a wide sheet of water,** which we call **a pool.**

A very large pool is called **a pond**; but **puddles, pools, and ponds** are all formed in the same way. They are **fed by running water,** and **streams of running water flow out of them**; but **their own water is still.**

II. A Lake compared with an Island

1. *Uncover the model now, and lead the children to examine and describe it.*

It represents **a large sheet of water with land all round it.** It is like a very large pond. We call it **a lake.**

2. *Compare it with the model of an island, which is land surrounded by water.*

Elicit that it is quite impossible to get away from an island at any point except in a ship or a boat, **because the water surrounds the land everywhere.**

An island is land surrounded by water, and **a lake is water surrounded by land**; but a lake is not the exact opposite of an island.

Show that although we can sail a ship quite round an island,

we could not walk all round the shores of a lake, *because all lakes (except a very few) have water running into them and out of them.*

III. How Lakes are Formed

1. *Refer once more to the pools and puddles in the roadway, and lead the children to tell that the water stands in these puddles,* **because the ground there sinks down into a sort of hole or hollow.**

The water flows into the hollow place and fills it up, but it cannot flow away, because the ground all round it keeps it in.

As more and more water collects in the hollow, some of it at last **flows over the edge,** and **runs away in a stream.**

2. *Tell that many lakes are formed exactly in this way, by streams flowing into some broad, deep hollow, from which the water cannot escape, till it reaches the edge of the hollow and overflows.*

Lakes of this kind **are only big pools of water** after all; but they are often so large that **they stretch for hundreds of miles** from one end to the other.

The streams which flow into such lakes, and those which flow out of them, are in nearly all cases **mighty rivers.**

3. *Call attention to the model now, and point out that this lake does not merely stand in a depression in the ground.*

It is hemmed in on all sides by mountains. The hollow which holds it **is formed by the valleys between the mountains**; but the mountains are grouped so close together that **the valleys,** instead of being broad and open, **are shut in on every side.**

Remind the children that the water which flows in streams down the mountain-sides, whether from springs or directly from

the rain, finds its way at last into the valley. **When the valley between the mountains is broad and open,** *it forms a natural bed or channel, along which this water can flow away towards the sea.* **The flowing water becomes a river.**

4. *Compare this with the water which flows down the sides of mountains, placed as these are in the model. There is* **no outlet** *from this basin-like cavity.* **The water cannot flow away;** *it collects and stands there, and so* **forms a lake instead of a river.**

Point out that, as the water collects, it must after a time find an outlet for itself somewhere round the rim of this basin, and then some of the water overflows, and **a river is formed running out of the lake.**

IV. Blessings of the Rain

1. *Lead the children in the next place to think of the rain as the source of all these streams and sheets of fresh water, which either flow through the land as rivers, or spread themselves out over it in the form of lakes.*

Point out that, with all the abundance of water in the sea, that water is **not fit for drinking purposes,** *either for ourselves or for any other living creatures except those whose home is in the sea; and that besides this* **it would destroy all our plant life.**

2. *Picture the rain falling on the dry, parched soil in the hot summer weather, and call attention to a few of the useful purposes it serves:—*

(*a*) It soaks into the soil, and **dissolves out of it nourishment for the support of the flagging plants,** which but for this would die.

(*b*) This work over, **it drains away from the soil** into ditches and water-courses, along which it flows to join the river, providing on its way **drink for the thirsty flocks and herds** in the meadows.

(c) As the river itself winds and curves through the upper part of its course, it is a clear, sparkling stream, and **water is pumped out of it and stored up** for the use of the people in the towns.

(d) But in all this part of its journey the river is useful in many other ways. **It turns the water-wheels of mills,** and it provides **a waterway for boats and barges and small steamers,** through pleasant meadows, between wooded slopes, past pretty villages, beautiful mansions, and lovely gardens.

(e) Lower down **it flows through towns and cities;** but here its waters are **fouled by the filth and refuse** poured into them **from the houses, workshops, and factories** on its banks. It is no longer the clear, sparkling stream it once was, but it is still doing good and useful work, for **it carries this refuse all away** in its onward course to the sea.

(f) Lower down still it opens out wider and wider **to form its mouth,** and here the tide flows in from the sea, and the salt water mingles with the water of the out-flowing stream to purify it.

3. *Picture the river in this part of its course, with ships of all sorts and sizes continually coming and going, and barges and other craft laden with merchandise, night and day moving on its waters.*

The vessels that come from distant parts of the world bring rich cargoes of food and other useful things for our support, and all kinds of material for our people to make up in the great factories. **They provide work for our workers.**

Those that sail away to distant parts carry back in exchange useful things of all sorts for the people who live there.

Picture the towns at the river-mouths where the ships **load and unload their cargoes.** *Describe the kind of work that goes on there. These towns are called* **seaports,** *or* **seaport towns.**

Summary of the Lesson

1. **A lake** is water surrounded by land.

2. **Lakes** are immense pools of still, or standing water. They are formed by water collecting in the mountain-valleys, or in hollows in the basins of rivers.

3. Nearly all lakes have rivers running into them and out of them.

4. The lake is really part of the river, which fills up the hole, and spreads out very wide on both sides.

5. **Seaports** or **seaport towns** are towns at the river-mouths, where ships load and unload their cargoes.

N.B.—*The usual lesson for modelling and recapitulation to follow.*

Lesson XV

RAINLESS DESERTS

The teacher should be provided with Brown's Pictures of "The Ship of the Desert" and "The Date-Palm."

I. Introduction

1. Our lessons have taught us many things about the sea and the ships that sail across it. To-day we are going to learn something about a new kind of ship. It is **the strangest ship** you ever heard of, for it goes along **without either sails or engines**,—it has **no such things as masts**, or **rigging**, or **rudder**, or **anchor**,—and **the men who manage it are not sailors.**

This strange ship is **never seen on the water**, for it is made to travel on the land; **it could not live in the sea.** Let me show you what our new ship is like.

2. *Show the picture of the camel, and ask the children to tell its name.*

This is the ship I mean, but it is not the kind of ship you expected me to show you, for you see it is the picture of **a living animal.** We call it **a camel,** but it has another name. It is also called **the ship of the desert.**

3. Let us see why it is called a ship. Ships carry people and their goods across the sea, **where nothing but a ship could go.** The camel carries its master and his goods across some parts of the land, **where only a camel could go.**

Those parts of the land are called **deserts,** and so the camel has got to be known as **the ship of the desert.** We must find out now what these deserts are like.

II. The Desert compared with the Sea

1. *Picture the open sea, where the sailors may go for weeks together without seeing anything but* **a great waste of water** *all round them, and the sky overhead.*

Then tell that in some parts of the world the land itself is simply **a great waste of sand,** *stretching (like the sea) for thousands of miles across.*

These immense tracts of sand are the **deserts** which we are going to speak about now. The largest of them, which is known as **the Great Desert,** extends for **2500 miles in one direction** and about **1200 miles in the other.**

2. *Lead the children to think of the traveller crossing one of these great deserts.*

As far as his eyes could reach he would see **nothing but sand**—*sand everywhere, and the sky above his head.* **He travels across the sand; the sailor across the sea.**

Elicit that the sailor on the pathless sea has nothing to guide him **but the sun, and the stars, and his compass,** *and then compare him with the traveller on this sea of sand.*

He has **no roads** or **paths** of any sort, for the winds are constantly blowing the sand about in every direction. **The sun and the stars are his only guide.**

3. *Picture the level stretch of water over which the ship travels, and then explain that these deserts are* **level tracts of land,** *for they are* **immense plains**—*not of course flat everywhere like the floor of the room, but altogether* **without either hills or mountains.**

In connection with this tell how **the winds heap up the sands in enormous ridges,** *which often reach as much as* 200 *feet and even* 300 *feet in height, and* **look like the swelling waves of the sea.**

4. *Ask the children whether they have ever tried to walk over some loose sand, and lead them to tell how the feet sink in at every step; and then proceed to show that the camel's foot is specially fitted for travelling across the loose, shifting sands of the desert.*

Like the sheep and the cow, the camel walks on its two toes; but these toes are **very broad,** and instead of being encased in a hard, solid hoof, they are furnished with **soft, wide, elastic pads or cushions** underneath. As the animal walks, **the pads spread out,** and so prevent the foot from sinking into the loose sand.

Compare such a foot with the small, hard, solid hoof of the horse. The horse is not fitted for travelling on such ground; his feet would sink into the loose sand.

III. The Intense Heat

1. *Tell and explain that these deserts are always found in the hottest parts of the world.*

The sun scorches like fire overhead, and the

torrents of heat which it pours down are reflected, or thrown back, by the red sands, so that in the glare of noon the air everywhere fairly quivers with the heat.

The sands themselves **look like red-hot waves**, and there is no shelter or shade of any kind, **no rest for eye or limb.**

If the traveller has to cross one of those hollows **between the piled-up ridges of sand**, he finds himself in a suffocating sand-pit, with burning walls on either side, and **scarcely a breath of air stirring.**

2. *Tell of the* **hot, scorching winds** *which sweep across the desert, licking up the loose sand as they go, and* **driving it in a dense cloud before them.**

Picture the travellers—men and camels too—as the sand-cloud comes near. They fall flat on their knees, and bury their faces in the sand, to prevent themselves from breathing the suffocating cloud which passes over them.

IV. No Water

1. *Proceed next to elicit from the class that in burning regions such as this there can be* **little or no moisture,** *for the dry, parched air would* **instantly change it into vapour** *and carry it away.*

Tell that it **never rains there,** *that* **clouds are never seen** *in those skies, that there is* **no such thing as a river,** *or a stream of any kind*—**not even a pool of water** *anywhere, and deduce as the result of this that* **no form of animal life**—*not even an insect—is ever found in these deserts.*

2. Plant life is almost as scarce, for nothing will grow in those dry, burning sands, **except a low, coarse, stunted kind of herbage,** which is found in small clumps here and there.

N.B.—*It is a mistake to represent the desert as being entirely destitute of vegetable life. Explain that* **this coarse herbage affords pasture for the camel,** *and that without it the desert would be a closed region altogether even to that animal.*

3. *This will be the time to show how the camel, even in its feeding, is specially fitted to be the ship of the desert.*

Call attention to the **great hump** *on its back. Tell that when the animal is fed well, this hump* **grows bigger and bigger** *from day to day. It consists of* **a mass of flesh and fat,** *and the camel can go without food, or with very little food, for a long time afterwards, because* **it feeds upon the store laid up in this hump.**

Tell too that the camel is a **cud-chewer,** *and that like the cow and the sheep it has* **four stomachs.**

It can store water in the honeycomb cells of its second stomach, and keep it for several days as pure as when it was first drunk.

When the camel is about to start on a journey across the desert, it is fed well for some time, and at the last moment **it is allowed to drink as much water as it can take.** Then with a handful of food now and then from its master, and by **browsing on the coarse herbage** it finds here and there, it is able to make its journey across the sands, where no other animal could live.

V. The Oases

1. *Lead the children next to think of the sea, and the islands large and small peeping up out of it, and then tell that there are* **islands in this great sea of sand.**

These islands in the desert are called **oases.** There are not a great number of them, and as a rule **they are hundreds of miles apart**; but they are of the highest

importance to the people who have to travel across the desert. One of them, which is known as **the Great Oasis, is 120 miles in length.**

2. *Tell that these islands, instead of peeping up out of the sand, always* **lie in hollows below the level of the rest of the desert** *all round.*

These oases are **fertile spots surrounded by burning sands,** just as real islands are surrounded by water. In the oasis, fruits and vegetables of various kinds are grown, but the most important plant of all to be seen there is the **date-palm.**

Show a picture of the tree.

Dates form the chief food of these people of the desert and their camels.

But let us see why the oasis should be fertile while all the surrounding region is nothing but burning sand.

3. *Point out that, as the oasis always lies in a hollow,* **whatever moisture there is beneath those dry, burning sands must drain down** *towards it from all sides.*

It is this **moisture in the soil** of the oasis which makes it **a fertile spot** in the midst of the desert.

Tell that those who travel across the desert make these oases one by one the **stopping-places in their journey,** *where they can rest themselves and their camels, and get a fresh supply of food and water to last them till they reach the next one.*

Summary of the Lesson

1. **Deserts** are dry, parched, sandy plains, hundreds and sometimes even thousands of miles across.
2. The camel is called **the ship of the desert.**
3. There are **no rivers** of any kind—there is not so much as a pool of water in these deserts.

4. There is **no form of animal life** in the deserts; and nothing will grow but a little stunted herbage.

5. **An oasis** is a green, fertile spot in the midst of the desert.

6. The desert is **an immense sea of burning sand**; the oases are like green islands dotted here and there in it.

7. The oases provide resting-places for the travellers who have to cross the deserts. At each one they get a fresh supply of food and water to last them till they reach the next.

SIMPLE LESSONS ON ENGLAND (MODEL AND MAP)

Lesson XVI

THE NORTH OF ENGLAND (First Lesson)

The modelling tray will be required, and in preparation for the lesson the teacher should make a model map on it in damp sand, in accordance with the plan here given. The principal mountain peaks and headlands would stand out best from the remainder of the model if they were moulded in clay; the rivers would show up well in silver cords; the lakes in the Lake District should be represented by means of small pieces of looking-glass, and small, round, bone discs or buttons should be used to represent the towns. A sketch-map should also be drawn in chalk, side by side with the model, on the part of the tray which is provided for that purpose, and a physical map of England will also be required. Provide a foot-rule for measurement purposes, and let the scale (6 inches to 50 miles) be prominently shown on both the model and the sketch-map.

I. Introduction

1. *Uncover the model and commence with a few minutes' chat about it, in order to awaken the interest of the children. Be careful to give no hint for the present as to its being a model of any part of England, for the main object just now is to use it*

simply as a connecting link between what has already been taught and the lessons that are to follow.

A little rapid questioning will elicit all they can tell about the model, and after leading them in this way to point out

examples of capes, bays, mountains and hills, rivers, estuaries, towns, and so forth, proceed as follows:—

2. One of the first things we should like to find out when we look at this model is whether it represents a large piece of land, or a small piece.

Is there any way of telling this? Yes, we must look at **the scale.**

What does the scale say? Six inches to 50 miles.

What does that mean? It means that every six inches on the model stands for 50 miles on the real sea and land.

Give one of the children a foot-rule, and let him measure from one side of the model to the other. Then lead him to tell, by means of the scale, that this length stands for a distance of **200 miles across the actual land and sea.**

This then is the model of a large piece of land and the sea near it; and I dare say you can now tell me what is the use of the scale? **The scale tells us the size** of this portion of land and sea which the model represents. We can also find **by the scale exactly how far any one point is from any other point.**

3. Now look at these letters N. E. S. W. on the four sides of the model.

What do they mean? They are the four cardinal points—North, East, South, and West.

This is the north side of the model, this the east, this the south, and this the west.

What do we learn from these points? We learn **the position of places,** and the **direction between any one place and another.**

Right. Now, as we clearly understand the meaning of the model itself, you would perhaps like to know that it is an actual model of part of our own country—England. Let us see what else we can learn from it.

II. Backbone of the Country

1. *Call attention to the shape of the country.* It is long and narrow from north to south, and it has the sea on both sides of it.

Notice in the next place the **long ridge of high land** *which stretches through the country from north to south.* These are **mountains.**

What name do we give to mountains which stretch in a long line, one after another, in this way? We call them a **range,** or a **chain of mountains.**

Tell that these mountains are known as the **Pennine Chain.**

2. *Notice that here and there in the chain* **one mountain stands up higher** *than any of the others near it, and elicit that these are called* **mountain peaks** *or* **summits.**

Some of the summits are **over 3000 feet high.** The highest of them is called **Cross-fell.**

Show this on the model, and write the name on the blackboard.

3. *Notice next that the range itself is* **much nearer the sea on the west side** *than on the east, and point out that the land must* **slope towards the sea on both sides.**

On which side should we expect the slope to be most gradual? Why?

Illustrate by referring to the **roof of a house,** *or compare it to* **a book set up on its edges** *with the back uppermost.*

It is **this long range of mountains** stretching through the country, that **gives the long, narrow shape to the land.** We often call the Pennine Chain **the backbone of the country,** because the land takes its shape from it, **just as an animal takes its shape from its own backbone.**

III. Shape of the Coast

1. *Notice, in the model, that the slope on the east side is very gradual; and* **the coast-line almost parallel to the mountains,** *till we come to a place where some hills* (Yorkshire[1] Moors and Wolds) *rise up near the coast.*

It will be sufficient to point out these hills **without troubling the children with names.**

These hills **break the slope** of the land, and the **coast-line too.** In one place they cause the coast-line to **bulge out like a great hump,** and in another they **form a bold, rocky headland.**

2. *Show from the model again that this is repeated on the*

[1] The name is not intended for the children.

west side of the great range—not by hills, but by **a cluster of mountains** *standing close together. Elicit that mountains placed in this way form* **a group,** *and tell that these are known as the* **Cumbrian Group.**

Tell that they are higher than the Pennines—one of them, **Sca-fell** (3162 *feet*), *is the* **highest mountain in this part of England.**

This group of high mountains near the sea, like the hills on the other side, break the slope, and seem **to push the land out farther into the water,** in the shape of a bold, rocky headland.

3. *Compare this part of the coast-line with the part to the south of it. Point out that here, where there are no mountains, the sea has been able to wear away the land little by little, and we find bays and other large openings.*

The shape of the land and the nature of the coast depend upon the mountains.

Summary of the Lesson

1. The mountains are the backbone of a country.
2. The Pennine Chain is a long range of mountains, which form the backbone of this part of England.
3. They determine the shape of the land, and the nature of the coast.

Lesson XVII

THE NORTH OF ENGLAND (Second Lesson)

I. The Watershed

1. *Introduce the model, and commence by calling attention to the* **silvery-looking, wavy lines** *on it.*

These represent **rivers.**

Notice that some of the rivers flow out into the sea on the east, and some into the sea on the west.

Elicit that **all rivers are formed from the rain,** *and that there is always* **more rain in mountainous districts** *than in the low, level plains.*

2. *Picture the rain falling on these mountains, and lead the children to tell that some of it* **must flow down one side** *of the mountains, and* **some down the other side.** Water cannot flow up.

The mountains **separate,** or **part the water** as it falls, and **make it flow in two different directions** down the slope.

This should be quite sufficient to recall the names **water-shed** *and* **water-parting.**

Lead the children to tell that the **Pennine Chain** *thus becomes* **the great watershed** *of all this part of the country. Hence some of the rivers flow into one sea, and some into another.*

3. *Notice next that the rivers on the east are* **much longer** *than those on the west, and elicit the reason for this by reminding the children of the position of the mountains.*

Mountains determine the length of the rivers, and the direction in which they are to flow.

II. Rivers

1. *Call attention to the great river*—**Ouse**—*on the east side of the line of watershed, and the numerous* **smaller rivers that run into it.** *Lead the children to tell the name for streams of this kind.* They are known as **tributaries** *or* **feeders.** Why?

Notice that each of these feeders, on its way to join the main river, flows for some distance **along its own valley** *between spurs from the great mountain range, and that the Ouse itself, throughout the greater part of its course,* **flows through a level tract of country.**

Elicit the general name for **flat land** *of this kind, and tell that this is known as the* **Plain of York.**

2. *Point out on the model how the river and its tributaries are* **hemmed in** *by high land on all sides, except in the direction in which they flow. Follow the course of the Derwent,* **to show why rivers wind about.**

What name do we give to the **land, which is drained by a river** and its tributaries? We call it the **basin of the river.**

This then is the **basin of the Ouse**; all the water which flows along this river is drawn **from the slopes of those hills and mountains**, which form the edge or rim of the river-basin.

3. *Pass on next to call attention to the mouth of the river, noticing how it* **widens out** *as it approaches the sea.*

What name do we give to the **wide mouth of a river into which the sea enters?** We call it an **estuary.**

Tell that this estuary of the Ouse is known as the **Humber,** *and then call upon the children to point out the other estuaries of the* **Dee, Mersey, Ribble, Tyne,** *and* **Tees.**

4. *The importance of such openings to ships and shipping should be pointed out, and this will naturally lead to a brief and rapid notice of one or two of the* **seaport towns** *on their banks,* e.g. **Liverpool, Hull, Newcastle.** *Needless to say, names are not the most important things now, although one or two may be given at the discretion of the teacher.*

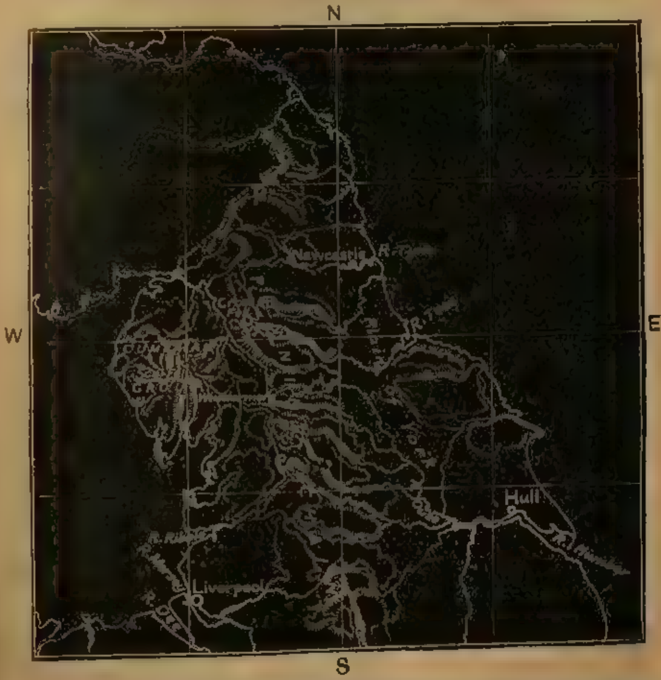
III. Lakes

Turn now to the Lake District. Point out in the model the little patches of water standing among the mountains.

Explain that these mountains stand so close together that, the water from the rain **cannot flow away in streams down the slopes.** *Instead of forming rivers therefore,* **it collects in the valleys** *between the mountains*—**the mountains hem it in, and surround it on all sides.**

What do we call **water with land all round it?** **A lake.**

These patches of water among the mountains then are lakes. There are so many lakes in this part of England



that we call it **the Lake District.** It is famed for the beauty of its scenery.

The largest of these lakes **(Windermere)** is about 14 miles long and between 1 and 2 miles wide. The word **mere** is another name for **lake.**

IV. The Map

1. *Uncover the sketch-map now which lies side by side with*

the model, and lead the children to compare the two. This, if carefully done, will have more effect in impressing upon them the true meaning of a map, than hours of teaching without it.

Point out that the map has to show, **on a flat surface,** *everything that our raised model shows, and call upon them to tell why we always represent hills and mountains in a map by means of shading (see Stage I., Lesson XXVI.).*

2. *Point out in the next place that the map is drawn to* **exactly the same scale as the model.** *The board is divided into six-inch squares, and every six inches represent* 50 *miles of land or sea.*

3. *Notice too that the positions of the four cardinal points are the same.*

Let the map be now slipped out from its place, and hung up before the class, **side by side with the wall-map of England,** *and ask the children to compare the two maps, noticing especially that* **the north part of both is at the top.**

Tell that maps are usually hung up before the class in this way, in order that they may be seen, and that as we now understand clearly the real nature of a map, our maps will be hung up too.

Maps are always hung with the north pointing to the ceiling, and the south to the floor.

Summary of the Lesson

1. Mountains form the watershed of a country. They determine the length of the rivers, and the direction in which they flow.

2. Estuaries are of great importance to ships and shipping. Seaport towns are built on their banks.

3. Lakes are formed in the valleys between groups of mountains, because the water cannot easily flow away.

4. Maps are always hung up with the north pointing to the ceiling.

Lesson XVIII

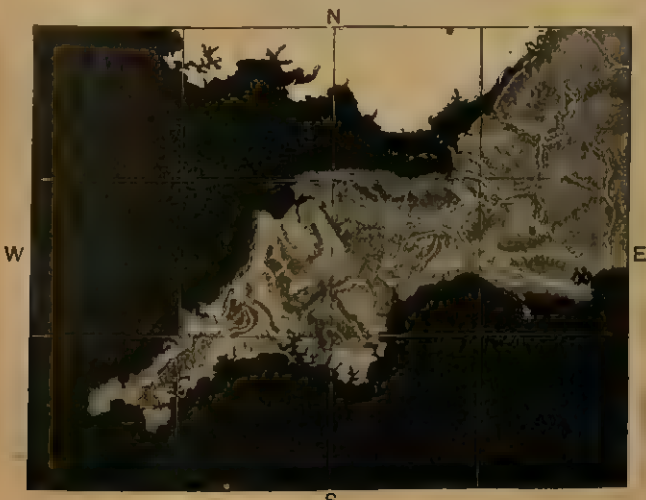
MODEL AND MAP (No. 2)

The teacher should be provided with a model-map, carefully prepared in the modelling tray on the lines laid down in the last lesson, and there must also be a sketch-map to show side by side with it, as therein explained. The wall-map of England (not political, of course) will again be required, and the foot-rule. Brown's Picture of "Land's End and Longships Lighthouse" will be useful.

I. Introduction

Uncover the model and proceed as follows:—

To-day we are going to learn something about another



part of our country—England. This model will show us what it is like, and so help us to understand the meaning of the map.

Point out, in the first place, that the tray is divided (as it was for the last model) into six-inch squares, and that the side of each square stands for 50 *miles.*

This model is made on the same scale as the last —6 inches for 50 miles.

Call attention in the next place to the letters N. E. S. W., representing the four cardinal points, on the four sides of the model, in order that the children may clearly understand the position in which the model is placed.

II. The Shape of the Land

1. Let us now pass on to consider the shape of the land, as it is shown in the model.

Who can tell me what name to give to **a long piece of land** like this **with the sea nearly all round it**? A **peninsula.**

If this is a peninsula what must we call the rest of the land to which it is joined? **The mainland.**

What do we call **that narrower part of the land** which joins a peninsula to the mainland? An **isthmus.**

Show me the part which we might call the isthmus in our model.

2. *Hang up the map of England now in front of the class, and call upon the children to point out on the map the part which is represented in the model.*

Call attention to the peculiar shape of this long, narrow part of the land, which stretches out into the sea. Compare it with the rest of the map.

Why should this piece of land have such a peculiar shape?

Let us try to find out the reason.

3. Think of the model of the other part of England, which we examined in our last lesson. What is it that gives that part of the country its shape? **The mountains.**

What name did we give to those mountains because of this? We called them **the backbone of the country.**

Then suppose we try to find the backbone of this part of England.

Show with the help of the model that, from the very extremity of the peninsula, **a long range or ridge of high land runs through the middle of it.**

4. *Tell that there are no peaks in the range high enough to be called mountains, and yet they are not smooth, rounded hills. They are formed of* **immense masses of rugged granite rock.**

These heights (the Cornish Heights) are **the backbone of this long, narrow peninsula.** As far as they run they **give the shape to the land.**

Notice that, where this range ends abruptly, **the land runs out into the sea** *in a bold, rocky headland. Tell that this great headland stands more than* 350 *feet above the sea;* **it is the end of the ridge of high land.** *The name (Hartland Point) should not be given for the present; it will come better later on.*

5. Point out in the next place that the land beyond this central range rises again, but in the form of **an extensive table-land** this time.

This table-land, which is known as **Dartmoor,** rises to a general height of 1700 feet above the sea-level, and is **formed almost entirely of granite,** although in parts it is **spongy bog-land,** on which it is highly dangerous to attempt to walk.

The huge granite rocks **(Tors),** which form **the highest peaks of this table-land,** tower to a height of 2000 feet above the sea.

Notice how much wider the land is here from sea to sea than it is in the other parts of the peninsula. Elicit that this is due to the table-land, which spreads out and covers all that large extent of country.

6. *Call attention next to the broad strip of mountain-land (Exmoor) which forms* **the northern edge of the penin-**

sula. *Describe the iron-bound coast here, whose rocky cliffs rise many hundreds of feet above the sea. They are* **the edge of these mountains. They give the shape to this part of the land.**

Point out (without giving any names) where these mountains come to an abrupt end just opposite Hartland Point.

Notice that the land between these two headlands is **much lower than the rest of the country,** *and lead the children to explain the reason for the great bay (Barnstaple Bay) which the sea has formed there.*

7. *Tell that in no part of England can we find such* **wild, rugged, rock-bound coasts** *as in this peninsula, and nowhere do such fearful storms occur.*

The extreme end of the peninsula is known as **Land's End.** It is a huge mass of granite which runs out from the rocky shore far into the sea, forming a bold headland.

The sea all round it is **crowded with immense rocks,** which rise up out of the water, and about two miles from the land lie some famous rocks known as the **Longships Rocks.**

This is a most dangerous spot for ships, and **a lighthouse is built on the rocks,** to warn sailors of their danger.

Picture the awful fury of the sea during a storm on these wild coasts. The waves are driven with such force, that they **sweep clean over the lighthouse,** *and frequently break the thick glass panes of the lantern, as they dash against them.*

8. *It would be well in connection with this to glance at the other rocky headlands—the Lizard and Start Point—but the names should not be given now. They will come better when the varying names for capes are dealt with in a later lesson.*

Similarly, the children might be exercised in pointing out in the model examples of bays, gulfs, and other inlets along the coast; but with the exception of **Plymouth Harbour, Falmouth Harbour,** *and* **Mounts Bay,** *no names should*

be given, and no notice need be taken now of the Eddystone, as it will be dealt with in a later lesson.

III. Rivers

1. *Pass on next to consider the rainfall in connection with the nature of the country. Elicit from the class that, as a rule, more rain falls in hilly and mountainous country than in other parts.*

Tell that the rule holds good here, for **the rainfall is very heavy.**

If so much rain falls then, why do we find so few rivers in this peninsula?

Notice that mountains and other high lands are not merely the backbone of the country, to give the land its shape; **they are also the natural watershed.**

2. The watershed of this long, narrow peninsula is very much like the ridge of a roof.

Sketch a roof on the black-board, and let the children tell the rest. **The ridge of the roof acts as a watershed.**

On such a roof, would the streams of water flow in straight lines to the gutter, or would they be likely to wind about? Would they be long or short streams?

Would they run swiftly or slowly?

3. *Point out now in the model that, the distance from the line of watershed to the sea on either side of it is so short, and the slope so steep, that* **there are very few real rivers.**

Here, as well as everywhere else of course, the water must drain away into the sea; but because of the nature of the ground, it flows in **short, rapid torrents.** There are very few actual rivers.

Point out the only rivers of any importance (Tamar, Taw, and Exe). The names are quite immaterial, **but the slope of the valley** *in each case* **should be carefully noted** *in the model, so that the children may clearly grasp the reason why the rivers flow in these different directions.*

Remind the children that we once spoke of certain rivers, which have their source **in streams flowing from spongy land,** *without any assistance from springs.*

Point out the Taw as a river of this kind. **It draws its water from the spongy bog-land of Dartmoor.**

IV. The Map

1. *Now will be the time to uncover the sketch-map which lies*

side by side with the model. Deal with it in precisely the same way, as was done in the preceding lesson. Call upon the children to find on the map all that has been pointed out in the model, and when that has been done, slip it out from its place, and hang it up before the class, by the side of the wall-map of England.

2. *Be careful to point out once more why maps are hung up in this way, and that they are always hung* **with the north pointing to the ceiling.** *The person looking at the map*

then has, **the east on his right hand** *and* **the west on his left.**

3. *Before closing the lesson it might be interesting to let the children find the towns in the large map. Notice* **how few towns there are in this part of England,** *compared with the part which was dealt with in our last lesson.*

Point out that the mountains determine **the shape of the country** *and* **its coast-line,** *and also the* **nature of its rivers.** *There are* **no large rivers here,** *and that is the reason why we find* **very few large towns.** *Explain in a simple way the reason for this if time permit.*

Summary of the Lesson

1. The south-west part of England forms a long narrow peninsula.
2. It gets this shape from the long ridge of mountains which run through it.
3. They form the backbone of the country, and give the coast its rugged shape.
4. There are no long rivers, because the slopes on both sides of the mountains are short and steep.
5. As there are very few rivers, we find very few large towns.
6. When a map is hung up with the north pointing to the ceiling, the east is on the right hand, the west on the left.

Lesson XIX

MODEL AND MAP (No. 3)

Provide for illustration the model-map and the sketch-map, prepared in a similar way to those in the preceding lessons. Have the physical wall-map of England and the foot-rule also in readiness.

I. Introduction

1. *Commence with a reference to the two preceding lessons for the purpose of eliciting that, in both cases, the shape of the country and the nature of its rivers depend entirely upon the position of the mountains and hills in it.*

Lead the children to tell that, in each one the long range of high ground stretching through the land becomes **the backbone of the country.** It not only gives the land

its peculiar shape, but it also determines **whether its rivers** on either side are to be **long or short, slow or swift, winding or straight.**

2. *Now uncover the new model, but before proceeding to investigate the details of it, endeavour to familiarise the children with it as a whole in the usual way.*

Call attention to the squares, and point out that it is built up, as the other models were, on a scale of **6 inches to 50 miles,** *and also call attention as before to the positions of the four cardinal points.*

Tell that this model represents another large piece of our own country—England; and that **this part is called Wales.** *Show on the wall-map of England the part to which the model refers.*

3. *The children should now be exercised for a few minutes in pointing out on the model examples of headlands, peninsulas, islands, bays, rivers, mountains, towns, etc.*

Call particular attention to **the large island off the north-west** *part of the coast. Tell its name*—**Anglesey**—*and note that it is separated from the mainland by* **a very narrow passage of water.** *Elicit that such passages of water are known as* **straits,** *and tell the name of this one* — **Menai Straits.**

Notice the smaller island—**Holyhead**—*close by. This too is separated from the larger one by a narrow strait.*

4. *Point out in the next place that* the land, as shown in this model, **is not a narrow strip with the sea on either side of it,** nor does it stretch out into the sea to form a long narrow peninsula. It has its own peculiar shape, and it is **as broad as it is long.**

A glance at the model will tell us that there are plenty of mountains in this part of the country.

Have these mountains anything to do with the shape of the land? Let us see.

II. The Shape of the Land

1. *Call attention to the model itself, and point out that* the whole of the surface seems to be made up of mountains and hills, with valleys between them. **Wales is a land of mountains, hills, and valleys.**

Notice that the mountains here, as a rule, **do not extend in long ranges or chains** *through the country.*

They form **distinct knots or groups,** which extend in all directions, and join one with another, giving the

whole surface of the country **a wild, rugged, mountainous appearance.**

2. *Point out that there is* **an important range in the north-west,** *and show what effect this range has in altering the shape of the coast here.*

It is this range of mountains which, by stretching out towards the sea, **forms that long, narrow peninsula.**

Call attention to **the principal peak** *in this range. Tell its name* **Snow-don,** i.e. Snow-mountain, *and explain that* **its top is covered with snow** *except in the height of summer.*

Its summit is 3571 feet high; **it is the highest mountain in England.** It gives the name—Snowdon—to the whole range.

3. *Show how the same thing is repeated by another range farther south, which also* **stretches out a long way into the sea,** *and ends in* **St. David's Head,** *one of the wildest and most rugged headlands on our coasts.*

Call attention to the great bend in the coast—**Cardigan Bay**—*between these two headlands.*

Throughout the whole of this great curve or bend **the shore is an iron-bound coast,** for the mountains come close up to the sea. There is not a single bay or other opening of any size in it.

Show this in the model, and then note the difference in the coast after passing St. David's Head.

4. Beginning with St. Bride's Bay, and Milford Haven (the finest harbour in England), we find **a succession of beautiful bays and other inlets** all along this part of the coast. Why is this?

Point out with the help of the model that the mountains here do not end abruptly by the sea; **the land slopes gently** *for some distance towards the shore.*

Lead the children to tell that it is **the sea which has made these openings** *into the land, and that it could not*

have done so had it been a rock-bound coast formed by the edge of the mountains.

In this part of the country, as in others, **the shape of the land depends upon the position and character of its mountains.**

III. Rivers

1. *Remind the children once more of the rule that in all mountainous parts of the country the rainfall is heavy—much heavier than elsewhere.*

More rain falls in Wales than in most other parts of our country.

Point out that the water which falls in rain must drain off the land in some direction towards the sea. **It cannot remain there.**

2. Look at that rock-bound western coast. What kind of rivers should we expect to find there? **Short, rapid, mountain torrents.** Why?

Now call attention once more to the knots or groups of mountains everywhere in the model, **with valleys winding about in every direction** *between them.*

Point out that, where mountains stretch in a long range through the country, the line of watershed is easily marked, and all the rivers are seen to flow down one slope or the other towards the sea.

In a land like this **there is no distinct watershed,** each mountain is drained into the valley at its foot, the valleys open one into another, and so **the rivers wind about in all directions.**

3. *It would be interesting and instructive in connection with this to trace on the model the course of two or three of these Welsh rivers, say* the Dee, Severn, and Wye, *in order to show* **how they wind about, and the reason for it.**

Needless to say, details and all names are to be avoided,

but the model itself would account for the windings of the rivers in every case. Take the Severn for example. The sloping valley leading from its source explains why it flows in one general direction, **till it is turned aside at the Wrekin.** *Then from this point* **the Clent** *and* **Cotswold Hills** *on one side, and the* **Malvern Hills** *on the other* **guide the flow of the stream** *in new directions, so that it reaches the sea at last by a very roundabout course, altogether different from that of a river which comes from a well-marked line of watershed.*

4. *Notice the* **wide mouth** *by which this river enters the sea, but say nothing for the present of the name by which it is known.*

It is **a great estuary up which the tide of the sea flows.** The tide here flows in very strong, and as it meets with the stream of out-flowing water from the river, it gives rise to **a very high tidal wave,** which is known as the **bore.**

This great estuary is of much importance to ships and shipping.

Point out in the model the important seaports **(Bristol, Swansea, Cardiff)** *and write their names on the black-board.*

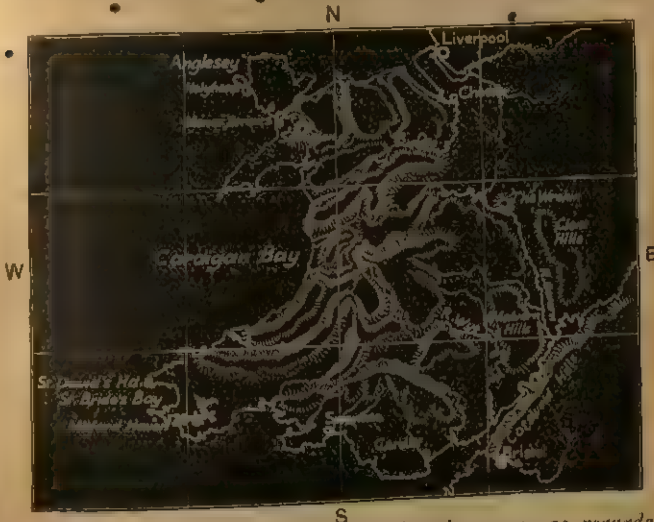
5. *Point to* **Chester** *at the mouth of the Dee, and compare it with* **Liverpool** *on the shores of the other estuary close by. These afford striking examples of the way in which one town decays and another rises.*

Chester was once a seaport, and carried on considerable trade; but the river mouth is now **choked up with sandbanks,** so that very few vessels—and those only small ones—ever enter it.

At the time when Chester was a flourishing port, **Liverpool was scarcely known.** It is now **the second seaport in England,** and its river, although a small one, is always **crowded with ships** of all sorts and sizes, from every part of the world.

IV. The Map

Uncover the sketch-map now, and proceed to deal with it in the usual way, making it the connecting link between the model and the large wall-map. Hang both up side by side before the class and compare them, and be especially careful in exercising



the children in the position of these hanging maps as regards the four cardinal points.

Summary of the Lesson

1. Wales is a land of mountains, hills, and valleys.

2. The mountains occur in knots and groups, which stretch in every direction.

3. In South Wales, where the mountains do not end abruptly by the sea, we find large bays and other openings in the coast.

4. The shape of Wales and the nature of its coast-line depend upon the position and character of its mountains.

5. It is the mountains which give the rivers of Wales their winding course.

6. The Severn enters the sea by a wide estuary.

Lesson XX

MODEL AND MAP (No. 4)

The modelling tray with model and sketch-map, both prepared beforehand as usual, will be required for illustration, and the teacher should also be provided with a foot-rule and the physical map of England.

I. Introduction

Introduce the new model, and point out that it represents all the rest of England which we have not yet examined.

Call attention to the four cardinal points on the sides of it, and compare the model itself with the wall map, in order that the children may get a correct idea of the relative situation of this, with regard to the other parts of the country.

Lead the children themselves to find that it comprises all the **eastern and south-eastern parts of England,** *and that the parts, which we have dealt with in the preceding lessons, lie in the north and west.*

Show by reference to the wall-map, where each of these other parts joins this one.

Call attention, in the next place, to the squares on the model, and show that this one is made on exactly the same scale as the other three—**six inches representing fifty miles.**

II. The Nature of the Country

1. Now let us have a good look at our model, and see what we can learn from it, as to the nature of the land which it represents.

The first thing to impress the children, as they compare this model with the other three, will be **the entire absence of mountains.** *They see* **no mountains or even high hills here.** *Lead them to tell this, and then point out that* **the general character of the country is level,** *although it is crossed here and there by ranges of low hills.*

2. The whole of the central part of the model represents **the Great Central Plain of England.** It extends from the Pennine Chain to the Cotswold Hills, and has the River Severn on one side, and **a ridge of chalk hills**

(the East Anglian Heights) on the other. *Point these all out on the model, without worrying the children with too many names. Facts and not names are the essentials here.*

This plain is **not one dead level throughout.** The surface **rises and falls here and there** with low hills

and valleys, although speaking generally **it is flat country.**

3. *Notice that in the model it gradually slopes down towards the sea; and point out that the land all round the great bay called* **the Wash** *is a* **very low, flat district.**

This is known as **the Fens,** and is **the lowest and flattest part of England.** It is so low and flat that the sea would overflow the land, but for **the banks or dykes,** which are built along the coast **to keep the water back.**

4. *Turn next to notice the land between the range of chalk hills and the sea on the east coast (Norfolk, Suffolk, and Essex).*

Point out that the whole of this part of the country is **one vast level plain,** *with here and there a few low and unimportant hills rising from it. (Essex is more hilly than the rest of this district.)*

5. *Lastly, call attention to the two almost parallel ranges of hills in the south*—**the North and South Downs.**

Tell that these are also **chalk hills.** *Trace them in the model from their commencement* **on the coast,** *till they become lost in the* **table-land of Salisbury Plain.**

They will be referred to later on in connection with the coast-line.

III. The Coast-line

1. *Commence with the neighbourhood of the Wash, and remind the children of the low flat character of the land all round this part of the coast.*

It is the constant wash of the sea here, **that has made this great bay,** by washing away the land little by little.

Point out that it would wash more and more of it away, **but for the bold cliff**—Hunstanton Cliff—**which forms the extremity of the range of chalk hills** (East Anglian Heights). *This forms a protection for the rest of the land.*

Trace on the model the whole of the coast-line from this

point, and show that (except in one or two places such as Cromer and Lowestoft) **the coast is a low, sandy shore.**

2. *Tell that in some places along the Essex coast the shore is so low that it has to be protected* **by sea-walls and banks.**

Notice how the sea has been at work on this coast. It is **much indented with openings,** *and there are* **many small islands, marshy flats,** *and* **sandbanks** *everywhere.*

3. *Contrast this with the part of the coast farther south, where* **the chalk cliffs appear again** *at the Forelands and Beachy Head.*

Remind the children that these chalk cliffs on the coast are **only part of the Chalk Downs,** *which run through the country.*

Beachy Head is an **immense mass of chalk** forming **a bold headland,** which towers 500 feet above the sea. **It is the extreme end of the South Downs.**

4. *This will be quite sufficient to prove to the children once more, that the nature of the coast-line of the country depends upon the character of its surface.*

Where there are **no hills or mountains** *the coast-line will as a rule be* **low and sandy;** *and where the surface of the land is* **mountainous or even hilly,** *there we may expect to find* **a rugged coast, with lofty cliffs and rocks.**

IV. Rivers

1. *Bring one of the children to the front, and let him trace on the model the course of the rivers, for the purpose of showing—*

(*a*) That this part of the country is exceedingly **well-watered.**

(*b*) That the rivers are **longer** and **more numerous** than in most other parts of the country.

(*c*) That they **flow in all directions.**

Point out, as the reason why they flow in so many directions, that there is no backbone of mountain-land running through the

country, and therefore **no distinct line of watershed,** *such as we find in other parts.*

2. *Pass on next to study these rivers in connection with the level character of the land through which they flow.*

Pour some water on a board held first in a slanting position and afterwards horizontal, and in this way lead the children to draw their own inferences as to the nature of these rivers.

They all flow with **a slow, winding course,** because **the land which forms their beds is everywhere nearly level.**

Compare a slow river with a rapid one as regards **its advantages to navigation,** *and explain that all these rivers are navigable.*

Deal with them briefly as follows:—

The Thames.—*Trace this river from its source. Tell its name, and explain that it is* **the longest and most important river in England.** *It is upwards of* 200 *miles long.*

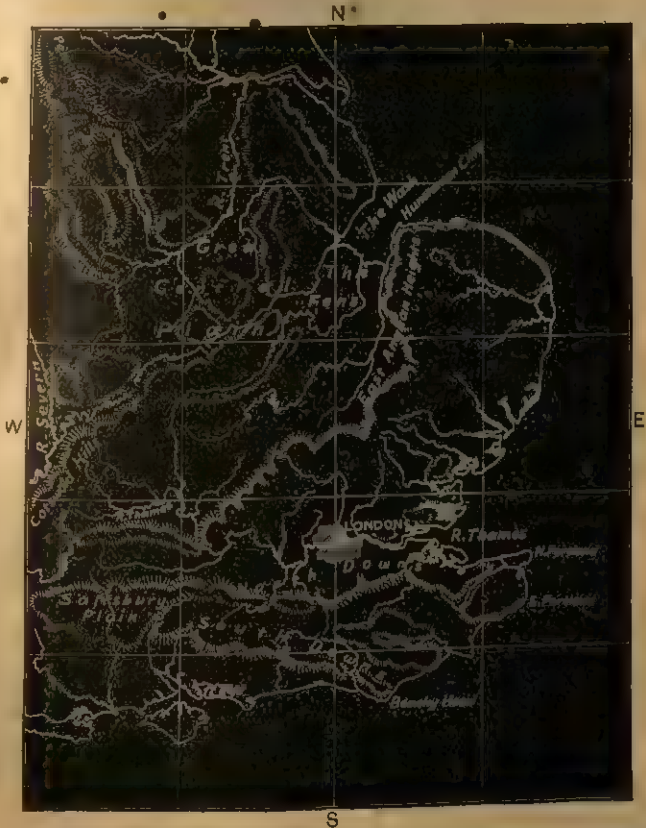
Notice how the valley or basin of the river is shut in on both sides, and call attention to the **numerous tributaries** *that flow into it.*

Notice also that **its mouth widens out** *to form* **a very large estuary;** *and tell that more ships are seen in this river than in any other river in the world.*

Show the position of **London.** *Tell that it is* **the greatest city** *in the world, and* **the most important seaport** *in the world. Upwards of* **20,000 vessels** *of all sizes, and from every land under the sun enter and leave this port every year.*

The Trent.—*The name is not important here; but it would be well to trace the river on the model, in order to show and explain, from the nature of the land, why it takes its peculiar course, and* **flows in a northerly direction** *to the Humber.*

The Rivers of the Wash.—*Glance at these in order to show that they rise in the Central Plain, which although not high land* **is higher than the Fens round the Wash.** *Hence they flow in this direction.*



Show, by referring to the model, that **the Central Plain becomes an actual watershed.** *Rivers flow from it in various directions—some northward into the Trent, one westward into the Severn, and one to the south to join the Thames.*

The Rivers on the East Coast.—*Point these out, and show that the range of chalk hills stretching up to the Wash forms* **the watershed, from which all of them draw their water.**

The Rivers on the South.—These are **all short rivers** of no importance. Why?

V. The Map

Uncover the sketch-map now, and deal with it in precisely the same way as in the former lessons, first comparing it with the model, and afterwards hanging it up side by side with the wall-map, for further comparison and recapitulation.

Summary of the Lesson

1. The mountains of England are in the north and west.
2. There are no mountains in the eastern and south-eastern parts. The land there slopes gently towards the sea.
3. The central part of England is a great plain known as the Great Central Plain.
4. The land round the Wash is a low swampy district known as the Fens.
5. The coast on the east of England is a low sandy shore, except where the chalk hills end and form cliffs.
6. The rivers in this part of the country are long, and flow with a slow winding course.
7. The Thames is the most important river in England. London stands on its banks.

Lesson XXI

ROUND ABOUT ENGLAND

Physical maps of England and the British Isles, and an ordinary wall-map of Europe will be required, and as usual a foot-rule should be provided.

I. Our Island Home

1. To-day we are going to learn something more about maps. Suppose we hang up the map of England, and begin at once with that.

Who can tell me why we always hang the map in this position? Because the top of the map is always the north.

Right. Now point out the south, the east, and the west parts of the map.

After this short introduction call special attention to the name Scotland in the extreme north of the map. Tell that Scotland is the land where the Scotch people live; but this map shows only a very small piece of it.

2. *Introduce the map of the British Isles now, and let the children show the position of England on this map.*

Point out that all the rest of the land to the north of England is called **Scotland.**

3. Now before we go any further I want you to notice that England is much smaller in this map than in the other.

What does that mean? It means that **this map is drawn to a smaller scale.**

What do you understand from that? **The same length** on this map **means a much greater distance** than on the other map.

Give one of the children a foot-rule, and let him show by actual measurements on the two maps that it is so.

4. Now look carefully at this large piece of land, which makes up England and Scotland. What do you notice about it? It has the **sea all round it.**

What name do we give to land which has water all round it? An **island.**

England and Scotland then make a large island. We call this island **Great Britain.**

England has water on the east, south, and west, but not on the north, for there it is joined to Scotland. It is **nearly surrounded by water,** but not quite.

What shall we call it? A **peninsula.**

Elicit that for the same reason **Scotland is also a peninsula.**

Call attention next to the other great island, and tell its name—**Ireland,** *the land* **where the Irish people live.**

Point out also the numerous islands all round the coasts of these two large ones, and tell that the whole group of islands large and small are known as **the British Islands.**

5. *Tell that:*

(1) **England**—*the southern part of the largest island—forms a land by itself;* **it belongs to the English people** *who live in it; it is* **their country.**

(2) **Scotland** *is* **another country;** *it is the land which* **belongs to the Scotch people.**

(3) **Wales is also a small country;** *the people who live in it are called* **Welsh.**

(4) **Ireland** *is the* **country** *of the* **Irish people.**

There are thus **three countries in the large island of Great Britain,** and only **one country** in the other.

II. The Land near England

1. *Introduce the map of Europe now, and ask the children to find on it the two large islands—Great Britain and Ireland—about which we have just been speaking.*

Let them point out the positions of England, Scotland, and Wales in the larger island, and then notice that, although these islands are **exactly the same shape** *in this map as in the other, they are* **very much smaller.**

Lead them in the usual way to explain carefully the meaning of this difference in size. **This map is drawn to a very much smaller scale.**

Let them examine the two scales, and prove it by actual measurement.

2. *Call attention to the great stretch of land, which reaches from one side of this map to the other. The children will observe that the two islands look quite small by the side of it. Tell that* **this land is many, many times bigger than our islands,** *and then proceed as follows:—*

What name do we give to the larger land which is situated near an island? We call it the **mainland.**

This large extent of land then is the mainland, but it has another name which we will learn now.

3. It is so large that **it contains a great many countries.** Notice that the map is coloured differently in different parts. **These different colours point out the different countries.** Here is one called **France**—the country of the French people; here is another—**Germany**—where the German people live; here is another—**Russia**—the home of the Russian people; and so on.

This great piece of land **which contains many countries** is called a **Continent.** It is the **Continent of Europe.**

4. *Remind the children that islands, as a rule, once formed part of the mainland close by, and lead them to explain how such islands have been cut off by the sea.*

Tell that this island of **Great Britain was once joined on to the great continent.** *It formed part of the continent. But the sea little by little washed away some of the land and made a passage for itself between, and so* **this land of ours was cut off from the mainland,** *and became a large island.*

Call attention to the **narrow part of the sea between England and France,** *but leave names for the present.*

III. The Seas round England

Point out that, although we always speak of the water all

round our island as the sea, yet different parts of the sea, like different parts of the land, have their own special names.

1. **The North Sea.**—*Point this out on the map, and show that it washes the whole of the east coast of Great Britain. It separates our island from the Continent of Europe. It is about* **400 miles across** *in the widest part.*

Tell that if we got into a ship at any place on our coast, and sailed across this sea to the land on the other side, we should find **strange countries,** *and* **strange people** *living there. Those people* **do not understand our language;** *we do not understand theirs. They are* **foreign people,** *and they live in a* **foreign country.**

2. **The Straits of Dover.**—*Notice how the sea narrows towards the south, till at the part, where the coast of England is nearest to the Continent of Europe, it is* **a narrow passage of water** *only about* **21 miles across.**

Point out that this narrow passage of water joins the North Sea to the other part of the sea farther south, and that it has England on one side and France on the other.

What name do we give to **a narrow passage of water** between two pieces of land? A **Strait.**

Tell that this is known as the **Dover Strait,** *and point out on the map the town of* **Dover** *on the English coast, from which it takes its name.*

Tell that on a clear day the French people from their side of the water can see the **white cliffs of Dover.**

3. **The English Channel.**—*Point out that the water which separates all the rest of England from France is also* **a narrow part of the sea,** *although it is much wider than the part near Dover.*

It is **a very wide strait,** for it joins the North Sea with the great mass of water to the south-west.

What name shall we give to a wide strait of this kind? **A channel.**

Tell that this is known as **the English Channel,** *and that it is a very stormy and dangerous part of the sea.*

4. **The Irish Sea.**—*Point this out next, and show that it lies between the two islands—Great Britain and Ireland.*

Notice that it has **two outlets to the open sea beyond** *—one in the north called the* **North Channel,** *which is only about* **12 miles wide** *at the narrowest part, and the other in the south, called* **St. George's Channel,** *which is about* **50 miles across.**

5. **The Atlantic Ocean.**—*Follow each of these outlets to the open sea, and tell that beyond them there stretches* **a great expanse of water thousands of miles across.**

We call it all the sea, but a great body of water like this has another name—**ocean.**

This great ocean is known as **the Atlantic Ocean,** and all the seas round England are only parts of it.

Point out where the English Channel, the North Sea, and the Irish Sea are all joined to this great ocean.

Summary of the Lesson

1. England and Scotland form a large island called Great Britain.
2. Ireland is another island to the west of Great Britain.
3. The British Islands lie to the west of the Continent of Europe.
4. The North Sea, the Straits of Dover, and the English Channel separate Great Britain from Europe.
5. The Irish Sea separates Ireland from Great Britain.
6. The great sea which stretches away to the west is called an ocean. It is known as the Atlantic Ocean.

Lesson XXII

OUR ENGLISH SEAS

A good outline map of England should be drawn on the black-board in readiness, but it should be left blank, so that the names may be filled in during the lesson. Brown's Pictures of "The Eddystone Lighthouse" and "Menai Straits" will also be required.

I. Introduction

Set up the outline map, call upon the class to tell what it is, and then commence as follows :—

In our last lesson we spoke of England as a peninsula. Why? Because it has water nearly all round it but not quite.

Come and show me which part of this map represents water.

Quite right. England has the sea on the east, south, and west, but not on the north.

What is there on the north? Land.

What is the name of that land? Scotland.

Call upon the children to name the seas on the other three sides. Fill in the names on the map as they are given, and then explain that our next business will be to learn something about **our coast waters,** *or those parts of each sea which wash our coasts.*

II. Our Coast Waters on the East

1. **The Humber.**—*Point this out on the map, ask for its name, and lead the children to tell that it is* **a great estuary,** *into which the Ouse and Trent pour their waters. Write the name on the map now, and let the children point out roughly the course of these two rivers.*

Remind them of the importance of great estuaries such as

this to shipping, and ask for the name and position of **the busy seaport town—Hull**—*marking it on the map as it is given.*

2. **The Wash.**—*Ask for the name of this great bay, and write it in the map.*

Call upon the children to describe the character of the land all round it, and lead them to tell that the sea has made the bay **by washing away the land,** *and overflowing the low, sandy shores.*

What becomes of the sand and mud which the sea washes away from the land in places of this kind? It is **piled up to form sea-hills.**

What name do we give to these sea-hills of sand? **Sandbanks.**

Tell that this great bay, although it stretches so far in all directions, is almost useless for ships, because it is **full of shoals and sandbanks,** *and the water is everywhere* **very shallow,** *owing to the shelving nature of the shores.*

3. **The Yarmouth Roads.**—*Remind the children of the generally* **flat, sandy character** *of all this part of the coast as shown in the model map, and tell that a few miles out at sea there is* **an immense sandbank,** *which runs almost parallel to the shore.*

What name do we always give to that part of the sea which lies between a sandbank and the coast? We call it **a road,** or **a roadstead.**

These roads are of great use to ships. Why? Because the sandbank **forms a natural breakwater,** and ships can anchor with safety in the roads when the weather is stormy outside.

Tell that these are called **the Yarmouth Roads** *from the town of Yarmouth on the coast. Mark it in the map.*

Explain that the sandbank itself is extremely dangerous, because the top of the ridge does not reach to the level of the water. **Hence light-ships are placed on different parts of it** *to warn the sailors of their danger.*

4. **The Mouth of the Thames.**—*Notice that this great estuary is* **the largest opening on the east.** *Refer to the low character of the (Essex*[1]*) coast, and remind the children that here as in the Wash the shore has to be protected in places by means of sea-walls.*

Notice what a great bite the sea has made in the land here, and tell that all along the (Essex[1]*) coast this part of the sea is* **full of shoals and sandbanks.**

Tell that here, as in all estuaries, **the tide flows a long way up the river.** *It reaches for 70 miles up the Thames.*

What name do we give to the estuary because of this? We call it a **tidal river.**

Lead the children to tell of the importance of this great estuary to shipping, and of **the immense number of vessels** *that enter it and leave it to and from the port of London.*

5. **The Downs.**—*Tell that off the south-east corner of England, near the entrance of the Straits of Dover, there is* **a very extensive sandbank** 10 *miles in length, known as* **the Goodwin Sands,** *and between this sandbank and the coast lies* **the most famous roadstead in our English seas.**

It is known as **the Downs.** The word **Downs** or **dunes** is only another name for **sand-hills.** The roadstead takes its names from the sandbank which forms it.

Tell that the Goodwins (although there are plenty of light-ships to point them out) are **more dangerous than any of the other sandbanks** *round our coasts, because of the stormy nature of the sea here.*

But if the ships can manage to steer clear of them, and get into the roadstead, they are perfectly safe, for **it forms a natural harbour,** where they can anchor while the bad weather lasts.

Hundreds of vessels may be seen anchored in the Downs during stormy weather.

[1] The name, in this instance again, is not intended for the children.

III. Our Coast Waters on the South

The first thing to notice here is the general absence of large openings along the coast. Tell that this south coast of England is famous for its **splendid natural harbours.**

1. **Spithead.**—*Call attention to the Isle of Wight, and the narrow strait which separates it from the mainland. Point out that* **the island itself forms a natural protection** *for these waters, and makes them a sheltered roadstead, where ships may ride in safety in spite of the stormy sea outside.*

Tell, and point out on the map, that the eastern part of this water is known as **Spithead,** *and that it is large enough for* **a thousand ships to anchor** *in at the same time.*

Notice the peculiarity of the name, and point out that **it has nothing to do with a cape or headland.** *This strange name refers to water not land.*

The other end of the passage on the west of the island is called **the Solent.**

Point out the two important harbours which are approached from these two straits, and give their names—**Portsmouth Harbour** *and* **Southampton Water**—*and tell briefly the purposes for which they are used.*

2. **Plymouth Harbour** *and* **Falmouth Harbour** *were both mentioned in one of the earlier lessons. Call attention to them now, enter the names in the map, and say a few words about* **the massive stone sea-wall** *or* **breakwater** *which has been built at the entrance of the former, and stretches for a mile out into the water to protect the harbour from the sea.*

3. **Eddystone Lighthouse.**—*No description of our coast waters would be complete without some mention of this,* **the most famous lighthouse in the world.**

Describe the dangerous reef of rocks situated in the midst of the English Channel, about 14 miles to the south of Plymouth Harbour, **in the very track of ships** *going up and down the Channel.*

Tell that at low tide **the tops of these rocks just peep above the water**—*at high tide they are* **completely covered.** *In olden times, before lighthouses were built, this was a terrible place for ships.*

Explain that the rocks take their name—**Eddystone**—*from the* **whirling eddies** *caused by the great waves, which roll in from the Atlantic Ocean, and dash and break up against them.*

Tell that the first lighthouse on these dangerous rocks was built in 1696; *that there have been several since then; and that* **the present one dates from 1882.**

Show the picture of it, and tell that the powerful light from its lantern **can be seen for a distance of 17½ miles** *across the sea.*

Lead the children, in the next place, to picture this terrible spot in foggy weather. Even these powerful lights from the lantern are of little use then, to warn the ships away from those sunken hidden rocks.

Call attention to **the two great bells** *at the top of the tower.*

Tell that in foggy weather these great bells, each of which weighs 2 *tons,* **are sounded every half-minute.** *They serve to warn the sailors of their danger,* **when the lights cannot be seen** *through the fog.*

IV. Our Coast Waters on the West

Lead the children to tell what they can of the sea on the west—**the Irish Sea,** with its two outlets, one in the north and the other in the south, *and then proceed to call attention to the principal openings* in the land on this coast.

1. **Bristol Channel.**—*This has already been mentioned*

in one of the earlier lessons. It will be sufficient now to point out that **it is wrongly named**—*that it is* **not a channel** *at all, but* **a great estuary.**

Call upon the children to tell what they can of it, and the rivers which pour their waters into it.

2. **Menai Strait.**—*Pass on next to notice the narrow passage of water between Anglesey and the mainland, glancing at the other openings on the way which have been spoken of before.*

Notice that this strait is so narrow that **it is crossed by two famous bridges**—*one for foot passengers and road traffic, and the other for railway trains, and that these bridges are* **high enough for large ships to pass under them.**

The coasts on both sides are **lofty and rugged**; hence these high bridges. *Show the picture.*

Passing by the other openings along the coast, which have been mentioned before, it would be well to notice

3. **Solway Firth,** *because of the peculiarity of the name. Tell that* **firth** *is* **the Scotch name** *for an opening which runs a long way into the land, and point out that this opening, which lies between England and Scotland, is* **the only one with that name.**

It would be instructive to notice too that **we have not met with a single gulf** *anywhere round our coasts. Tell the reason for this. The name* **gulf is a foreign** (*Italian*) **word**; *it has never been given to any of the openings on our English coasts. We find it in other maps, but not in a map of England.*

Summary of the Lesson

1. The principal openings on the east of England are the Humber, the Wash, and the mouth of the Thames.

2. The Yarmouth Roads and the Downs are important roadsteads near the coast.

3. The openings in the south coast are small. They form splendid harbours.

4. Spithead, the Solent, Portsmouth Harbour, Southampton Water, Plymouth Harbour, and Falmouth Harbour are the most important of these openings.

5. Eddystone Lighthouse, the most famous lighthouse in the world, is near Plymouth Harbour.

6. Bristol Channel is not really a channel. It is the estuary of the Severn.

7. Solway Firth is the Scotch name for the opening which lies between England and Scotland.

Lesson XXIII

OUR COASTS

Have a good outline map drawn on the board in readiness as in the last lesson, and fill in the names as the lesson proceeds. Brown's Pictures of "Flamborough Head," "Beachy Head," and "The Needles" should be shown.

I. On the East

Set up the outline map, and by referring the children to the model maps (Lessons I. and V.) lead them to tell that the general character of the east coast is **low and sandy.**

Elicit, as the reason for this, that there are **no hills of any importance** *in that part of the country, and that* **the land gradually slopes from the mountain regions** *of the north and west.*

Ask them to look along this coast, and try to remember from the model whether there is any hilly ground at all near the sea, and in this way lead them to point to the Yorkshire coast,[1] *where the high land runs out into the sea, forming the bold rocky headland :—*

Flamborough Head.—*This was pointed out on the*

[1] Point it out without of course any reference to the name.

model. Show a picture of it now, and tell that it is **the most striking headland on the whole of this coast,** *for it stands* **450 feet** *above the level of the water, and runs out into the sea for several miles.*

Tell its name now, and account for it by the fact that long long ago, before the days of lighthouses, **people used to light beacon-fires** *on its summit to warn sailors away from the rocky coast. The* **flames** *from these fires could be seen a long way out at sea.* Hence the name **Flam-borough Head.**

Instead of a beacon-fire there is now **a lighthouse on this cliff,** and the powerful light from it can be seen on a clear night **for fully 35 miles.**

Spurn Point.—*Show this on the map. Tell that in some maps it is called Spurn Head, and then proceed to explain why that is a very bad name for it.*

It is **a long tongue of low, flat sand and shingle** stretching out into the sea, and the waves are little by little washing it away.

Ask the children to compare this with the bold rugged cliffs of a headland, and so lead them to see that **Spurn Point is a much better name than Spurn Head.**

Picture the dangers of such a ridge of sand to vessels entering the Humber.

It is considered so dangerous that, not only are there **two lighthouses on it,** but at some little distance from its extreme end **a light-ship is stationed** with **a powerful light** for clear weather, and **a bell** to give further warning when the weather is foggy.

Lowestoft Ness.—*Mark this on the map, and tell that it is* **the most easterly point in our island.** *The name* —**Ness**—*is the most interesting thing about it just now.*

Tell that when the sailors of old saw a sharp lofty cliff like this stretching out into the sea, they fancied it looked **something like the nose** *which projects out from the face.*

A thousand years ago some sailors from the other side of the North Sea (fierce sea-rovers they were) settled in

this country. Their word for **nose** was **næse** or **naze**, and they gave that name to this cliff. We have changed **næse** into **ness**—that is all.

Point to the **Naze,** *a little farther along the coast, as another example of the use of this name.*

North and South Forelands *have already been pointed out in the model in connection with the chalk downs. The names may be given now.* **They are bold chalk cliffs.**

II. On the South

Dunge Ness.—*Show the position on the map. Tell that in this narrow part of the sea* **the great tide-wave,** *which flows in from the Atlantic,* **meets with another tide-wave** *from the North Sea, and in the struggle between these two great masses of water,* **sand and shingle are washed up,** *and thrown on this part of the coast.*

In that way **a long broad ridge of shingle has been formed here,** which already stretches **4 miles out** from the shore, and every year increases in length by about 20 feet.

Tell that its name **Dunge Ness** *is really* **Danger Ness.** It is a most dangerous spot for ships, although there is **a good lighthouse on it,** to warn the sailors of their danger.

Lead the children to tell why the name **Ness** *is* **not a good one** *for a cape of this kind.*

Beachy Head.—*This has already been pointed out in the model and described. Show the picture of it now, and lead the children to tell what they can about it, and then pass on to*

The Needles.—*Show the picture of these interesting rocks. It will be more effective than the most careful description without it.*

Point out their position on the map. Tell that **they are made of chalk,** *and that the sea is little by little washing them away.*

Call attention to **the lighthouse on the outer rock.** *Tell that the sea dashes with such force on these rocks that, although the top of the lighthouse is 100 feet high,* **its lantern windows are often broken by the stones,** *which are hurled up by the waves during a storm.*

Portland Bill *is another interesting cape, because of its name*—**Bill.**

Tell that this name was given to it because it was thought to have a sort of likeness to the **head and bill of a bird.**

It is **an island at high water,** but when the tide is out, it is found to be joined to the mainland by **a long ridge of loose shingle and pebbles** called the **Chesil Bank,** which is more than 10 miles long.

Start Point, the Lizard, and Land's End *were all described in connection with the model as* **bold rocky headlands.** *Elicit from the class all they can tell about them now, and give their respective names.*

Show that **point** *is* **not at all a good name** *for capes of this kind.*

Start Point is **a rocky headland 200 feet high,** and the Lizard is formed of such wild lofty rugged rocks, that **two lighthouses are found necessary** to warn ships away from them.

III. On the West

Hartland Point.—*This lofty rugged headland was pointed out and described in connection with the model map, although no name was given then.*

Give it now, and show that here again the name—point—*is not a good one. Let the children tell what they can of* **this dangerous headland.**

Great Orme's Head.—*This should be pointed out and named, as it is* **the most lofty headland on the shores of our island.**

It towers upwards to the height of **750 feet,** and stretches out into the sea for fully 3 miles beyond the rest of the coast.

It will be interesting now to notice that all round our English coasts we have not once met with a single **cape.** *Lead the children to tell the reason why.*

Capes are **heads,** and **heads** are **capes,** but the name **cape is a foreign word.** We prefer to call our capes by the English word—head.

We find plenty of capes in other maps, but not[1] in a map of England.

Summary of the Lesson

1. Flamborough Head, Spurn Point, Lowestoft Ness, the Naze, North and South Forelands are capes on the east of England.

2. Spurn Point is not really a cape or headland. It is a low ridge of sand which stretches out into the sea.

3. Beachy Head, the Needles, Portland Bill, Start Point, and the Lizard are capes on the south.

4. Dunge Ness is not properly speaking a cape. It is a ridge of sand which is formed by the tide.

5. Beachy Head and the Needles are chalk cliffs. Portland Bill, Start Point, and the Lizard are immense rocky headlands.

6. Hartland Point, St. David's Head, and Great Orme's Head are rocky headlands on the west.

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[1] As a matter of fact Cape Cornwall and one or two others are met with on different parts of the coast, but they are too unimportant to be named on an ordinary school map, and for our present purposes they may be passed over.

SIMPLE LESSONS ON THE SHAPE OF THE EARTH

Lesson XXIV

THE EARTH IS NOT FLAT

The teacher should be provided with a large ball, ten or twelve inches in diameter (larger if possible); and Brown's Picture, "What the Look-out Man sees."

I. Introduction

The rotundity of the earth is a most difficult subject to present to young children, for it is a direct contradiction of the evidence of their own senses. They see for themselves everywhere (except of course in hilly parts of the country) that the land looks as flat as their school playground, and those of them who have been to the sea, know that the surface of the water too looks perfectly flat and level, as far as their eyes can reach.

Yet (strange as it may seem) **this very knowledge, which comes from their own observation, must be made the starting point,** *from which to set out to prove the real shape of the earth. Commence in some such way as this:—*

1. The sky, as we have frequently said before, **has the appearance of a huge basin** placed upside down on the earth.

Wherever we may be, if we look up at it, we find that **we are exactly under the middle of this basin.**

The rim of the basin forms a great circle or ring all round us, **where the sky seems to touch the earth,** and we ourselves are **in the centre of the circle.**

What name do we give to this circle where the sky and the earth seem to meet? **The horizon.**

2. *Explain that the word* **horizon** *means* **a boundary,** *and that we call this line the horizon or boundary,* **because it bounds our sight.** We cannot see anything beyond it except the sky.

Let the children imagine themselves in a boat far out at sea, with only the sky above them, and water on every side. Beyond the circle of the horizon, where the sky and the water seem to meet, **they would see nothing at all.**

3. *Point out that this would not be due to any weakness of sight, for* **even with the help of the finest telescope,** *they would see nothing beyond the horizon.*

The telescope would make the ring of the horizon look clearer and more distinct, **but it could not show them anything beyond that ring;** and from their position in the boat **the horizon itself would be only a few miles distant.**

That is to say, they would not be able to see anything more than a few miles off, because all round them would be the horizon as **the boundary of their sight.**

II. What the Horizon Teaches

1. *Remind the children, in the next place, that we have heard of lighthouses,* **whose lights can be seen for a distance of 30 miles,** *and elicit the reason for this.*

These lights are placed **on the tops of very lofty towers.**

Point out too that the sailors at sea have to keep a sharp look-out; they must see all round them as far as they can.

Where does the captain place the look-out man? **At the top of the mast.**

2. *Tell in the next place that a person standing in the middle*

of a wide plain, like the one in the boat, would be unable to see anything more than a few miles off, **because the horizon all round him would bound his sight.**

What would be a good thing for him to do, if he wanted to see more of the country? He might go to the **top of some high building,** such as a church steeple.

3. Now let us think of this man and the look-out man at the mast-head. They both get into these high positions because they want to see as far as they can, and they are able to see a long way farther than they could lower down. But even then they see in the far distance all round them **a circle, where the sky seems to meet the sea or the land.** This circle is their **horizon,** and it shuts off their view, and **prevents them from seeing any farther.**

It will in this way be an easy matter now to make the children clearly understand that this boundary circle, the horizon, **is not always the same distance from us.** *The horizon, which the man on the mast-head or the other on the church steeple sees,* **is much farther off** *than that which bounds the sight of those in the boat or on the ground.*

4. *Illustrate this further as follows:—Imagine a fly to be standing on the table. It would see clearly any object at the far end of the table. If its eyes were strong enough,* **it would be able to see for any distance on a flat surface** *like this, because there is nothing to shut out the view. But it cannot see a thing if it is held just over the edge of the table,* **because its eyes, like ours, are made to see straight in front of it,** *and not to look round corners.*

5. *Show a very large ball of some kind now*—**not of course the geographical globe at this stage.** *Imagine the fly to be standing somewhere on this ball, mark a couple of spots on the ball, and lead the children to tell that the fly from its place* **would be able to see one spot and not the other.**

Between the two marked spots **the surface of the**

ball bends or curves away from the fly, and **its eyes cannot look round corners or round a curve.**

6. *Draw a circle on the ball round the fly to show the extent of its vision.* This circle would be the fly's horizon. The fly would not see the mark beyond the circle, **because the bulging, curved surface of the ball would stand in the way.**

Now stand a stick of chalk on the ball, and imagine the fly to be stationed on that. Point out that it will be able **to see more of the ball now,** *and draw a circle to show the extent of its view in the new position.*

That circle would be its **new horizon.** It would not see beyond it, for beyond it **the ball still bulges and curves.** But it can see the second marked spot which it could not see before.

7. *All this should be elicited from the children experimentally step by step, as far as possible; after which point out that the same thing would happen on any part of the ball,* **because the ball has everywhere a curved surface.** *It is that which makes it a round ball.*

8. *Apply these principles now as follows:—*

(*a*) If the earth were flat as it seems to be, **there would be no such thing as a horizon** to bound our sight, and the telescope would show us what our naked eyes could not see.

(*b*) We should see **no farther from the top of a church steeple** than from the ground.

(*c*) The look-out man at the mast-head and the man on the church steeple see so much farther than the man on the ground, **because the sea and the plain,** although they appear so flat, **actually bend round,** as the surface of the ball does, **in a great swelling curve.**

(*d*) It is this great bulging, swelling curve of the sea or land which **forms our horizon** wherever we may be. It shuts out our view of the rest of the curve farther

away. **We cannot see beyond it,** because our eyes, like those of the fly, are made to see straight in front of us, and **not to look round a curve.**

(*e*) **The sky does not really touch the earth at the horizon;** but the curve of the earth's surface shuts out the view of everything beyond it, and **we actually look over the edge of this curve into the sky above.** To us it seems as if the sky bent down there and touched the earth.

(*f*) Our earth, wherever we may be on it, has the same curved surface, and it is this curved surface which forms the horizon to shut out our view.

The earth is a great round ball, and we walk about on the outside of it, as the fly walks about on this ball.

III. What we Learn from Ships

1. *Turn to the ball once more. Imagine a fly walking about on it. Lead the children to tell that, if it kept its head steadily fixed in one direction, and walked on and on,* **it must at last come back to the place from which it started,** *because the ball is round. Let them do this for themselves with an artificial fly.*

2. *Now lead them to imagine a bird of some kind let loose from its cage, and picture it flying away with its head steadily fixed in one direction, say towards the west, till it is lost to sight.*

Imagine it strong enough to keep on and on, day after day, month after month, **always in the same direction, never turning its head.** *It would leave England behind; it would cross over the great wide ocean to the west (the Atlantic); it would come to other lands and other seas; and if it still kept on in the same course, without turning its head,* **it would at last come back to us here**—*to the very place from which it started.* **But it would fly home from the east,** *not from the west.*

3. Remember, the fly on the ball started in one direction, and **came back to its starting place from the opposite direction.**

Why was that? **Because the ball is round.**

Our supposed bird in the same way would start towards the west, and **by keeping on in the same direction without ever turning,** come back to us from the east.

4. *Tell that although this is a fancy picture as far as the bird is concerned, ships are constantly doing much the same thing. They set out in one direction, and without turning round,* **they come back from another.** *They may start, as the bird did, towards the west, and* **return from the east;** *or they may start towards east, and* **come back from the west.**

Point out that the ships cannot make such a straight course as our imaginary bird, because wherever they meet with land, they cannot sail across it, they must go round it. But **if** (allowing for the land that they meet with on their way) **they keep on steering in one direction** *without changing their course,* **they always return home from the opposite direction.**

What conclusion, therefore, must we come to about the shape of the earth? **The earth must be a great round ball.**

Summary of the Lesson

1. The horizon is the line where the earth and sky seem to meet. This line bounds our sight. Beyond it we can see **nothing but sky.**

2. The horizon forms a circle all round us, and we are in the centre of the circle wherever we may be.

3. We can see farther from the top of a church steeple than if we are standing on the ground, because the horizon is then farther off. This could not be if the earth were flat.

4. We cannot see beyond the horizon, because the earth is a great ball. Its surface everywhere bends round in a curve, and we look over the edge of the curve into the sky above.

5. If ships set out in one direction, and keep on without changing their course, they always return home from the **opposite direction.**

Lesson XXV

THE GREAT BALL WE LIVE ON

The ball used in the last lesson will again be required, and the teacher should also be provided with a small toy ship, the chalk compasses, and a foot-rule.

In preparation for the lesson the children, if possible, should have been taken to some little rounded hill in the neighbourhood for observation.

Failing an actual hill, the rounded bridge over a canal or a railway cutting would serve the purpose equally well.

Station the children near the foot of the rising ground on one side, and let them watch and observe for themselves the people and vehicles coming and going on the other slope.

I. Introduction

Commence in class with a brief and rapid recapitulation of the leading facts of the preceding lesson, as follows:—

What is the meaning of the word horizon? It means **a boundary.**

Why do we give this name to the line where the sky seems to touch the earth? Because it shuts off from our view the part of the earth beyond that line. **It bounds our sight.**

How do you account for this? Beyond that line the earth curves down and away from us. **We look over the edge of the curve**; but we cannot see what is on the other side of it.

Whereabouts on the earth does this occur? Every where.

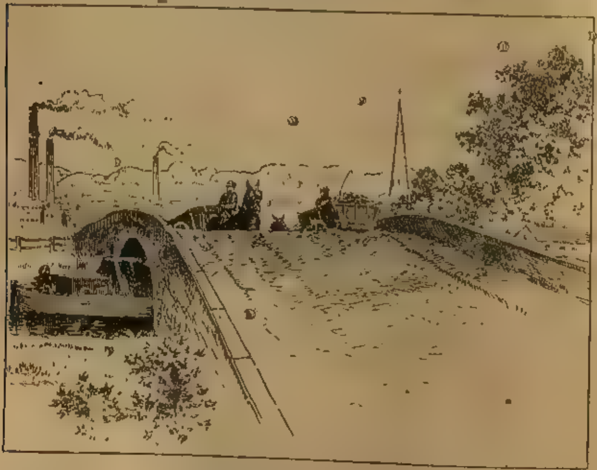
What does that teach us? It teaches us that **the earth is a great round ball.**

What other proof can you give me that the earth is round? Ships sail away from a place in one direction, and by keeping the same course, **they return home from the opposite direction.**

Refer once again to the fly on the ball. In whatever direction it started, if it kept its head in the same course, it always returned to its starting place from the opposite direction. So with the ships. **If they set out on a direct course towards the west, they return from the east;** if **they start for the east they return from the west.**

II. More about Ships

1. *Tell that we are now going to see what else the ships can teach us, but we shall understand all this much better if we*



begin with something a little nearer home; and then proceed in some such way as this:—

I want you to think of what you saw from the foot of the canal bridge this morning.

The road, you remember, rises gently from the foot to the middle of the bridge, just as if it were a little hill.

But what did the road on the other side look like as you stood there? We cannot see the road on the other side from the foot of the bridge.

Why not? Because it bends down away from us; **the highest part of the bridge hides it from us.**

What does that bring to your mind? **The horizon.**

Why? Because the rounded edge of the bridge **bounds our sight**, and shuts out from our view the part of the roadway which bends down.

2. Exactly. Now I want you to think of the people, and the carts and waggons, which were coming and going over the bridge.

Perhaps some of you noticed those that were coming towards us from the other side of the bridge.

What did you see first? **The men's hats** and **the tops of the waggons** were the first to show above the middle of the bridge.

What happened after that? More and more of the men, the waggons, and the horses came into view, little by little, till at last everything was plainly seen down to their feet.

3. Quite right. Now tell me about the other people and waggons that went over the bridge away from us.

Which parts of them did you first lose sight of as they went over the middle of the bridge? **The feet and legs of the men and the horses,** and **the wheels of the waggons.**

What was the last you saw of them? **The men's hats** and **the top of the waggons.**

Quite right. Now I think you will easily understand what the ships teach us.

4. *Produce the ball of last lesson, and imagine a fly to be standing on a certain spot on it. Lead the children to point*

out that the fly would see only a small part of the ball from where it stands. **Its horizon would shut off from view all that part of the ball which curves down and away from it.**

Mark a circle round the supposed fly to show that horizon.

Now move the little ship up the ball slowly towards the circle,

WHAT WE REALLY SEE.

and let the children see for themselves that the fly from its position would first of all **catch sight of the top of the mast,** *as it peeped up above the horizon.*

Continue to move the ship onward till it comes within the circle, and then elicit that **the whole of it would be seen,** *hull as well as mast.*

Turn it round now, and move it away from the fly beyond the horizon, and lead the children to point out that this time **the hull is the first part to disappear,** *and the top of the mast is the last of the ship which the fly would see.*

5. *Point out further that the same thing would happen on*

every part of the ball, **because it is round all over,** *and compare these phenomena with the observations made by the children on the bridge in the road. Now tell*

(*a*) *That if we watch a ship come to land on a clear day,* **we always see first of all the tops of the masts peeping up above the horizon,** *then as it approaches nearer and nearer, we see the sails, and at last the whole body of the ship comes into view.*

(*b*) *That if, on the other hand, we watch a ship sailing away,*

WHAT WE SHOULD SEE IF THE EARTH WERE FLAT.

we lose sight of the hull first of all, *and the last thing we see of it is the top of its mast as it disappears below the horizon.*

6. We see exactly what the fly on the ball would see, **for our earth too is a great ball,** and we cannot see beyond our horizon, **because we cannot see round a curve.** That is why we lost sight of the men on the other side of the bridge; that is why we lose sight of the

hull of the ship when it is a long way off. **It is below our horizon.**

7. *Show carefully that if the earth were a flat surface, we should continue to see the whole of the ship, as it sailed away, just as if it were close by us, although of course it would appear smaller and smaller, as it got farther off, till in the distance* **it might seem a mere dot.** *But even when our eyes failed,* **the telescope would show it to us again,** *and it would be the whole ship*—**no part of it would be hidden by the water.**

III. Why the Earth Appears Flat

1. *Mark on the black-board with the chalk compasses as large a circle as possible—a radius of 18 inches or even more if the board is wide enough.*

Now measure off with the foot-rule **an inch of the circumference,** *and call upon one of the children to place the edge of the ruler close up against this part of the line.*

What do we see? The figure on the board is a circle. It is **perfectly round everywhere.** Yet, when we look at this little piece of the line, **it seems to be quite straight** with the edge of the ruler.

2. We have only to apply this to the surface of the great ball on which we live, and we shall easily understand why it seems to us to be flat, although we know it is actually round.

The reason why this piece of the circle seems to be a straight line is that **it is so very small compared with the size of the circle itself.** We do not notice any roundness or curve in it.

If, instead of a circle, we had a large ball the same size—a yard across—and we could cut away a piece of the surface of the ball measuring say an inch across, just as we peel an orange, say, that piece of the round ball

would lie flat on this table, for it would itself be quite flat.

The reason why the surface of the earth appears flat to us is that, **we see such a very small part of it** compared with its immense size.

Our great ball on which we live **measures nearly 25,000 miles round,** and we, at the best, **can see only a very few miles** of this at one time. The little piece which we see is like the piece of the circle. **It appears quite flat;** we do not notice any roundness or curve in it.

Summary of the Lesson

1. If we watch a ship come to land from a distance, we see first the tops of the masts, then the sails, and last of all the hull.

2. When we watch a ship sail away from the land, we lose sight of the hull first, and the last we see of it is the top of its mast, as it disappears beyond the horizon.

3. This is because the lower part of the ship is hidden by the curve of the horizon.

4. If the earth were flat, the ship would seem to get smaller and smaller as it sailed away, till it looked a mere dot. But even then no part of it would be hidden, because there would be no curve in the water to hide it.

5. The earth and sea seem flat to us because we can see such a very small part compared with the size of the immense ball itself.

Lesson XXVI

THE TRUE SHAPE OF THE EARTH

The following articles will be required for illustration:—the chalk compasses, two small smooth wooden balls about the size of a penny—one of them sawn in halves, an orange, a large knitting needle, the school globe, and a piece of tape.

I. Circle

1. In our last lesson I drew a circle with the compasses on the black-board. I will draw one now, but for another purpose.

You notice that I stick one leg of the compasses in the board, and sweep the other leg round, so that the chalk at the end of it makes a curved line, and that the two ends of this curved line meet at last and make a circle.

I will mark the point where I stuck the leg of the compasses.

Do you know what we call this point? **The centre of the circle.**

What can you tell me about it? It is **the exact middle of the circle.**

Every part of the chalk line is the same distance from it.

2. *Tell that the chalk line itself which makes the circle is called* **the circumference—the measurement round the circle**—*and that if we rule a straight line with a ruler through the centre from one side of the circle to the other, we get* **the measurement through the circle,** *and this line is known as* **the diameter—the through measure.**

Draw several diameters, and show that they are all exactly the same length, **because every point on the circumference is exactly the same distance from the centre.**

3. What does this circle with its diameters drawn across it call to your mind? A cart-wheel.

Point out that the cart-wheel rolls evenly and smoothly along without any jolting simply **because it is a perfect circle,** *and all its spokes are exactly the same length.*

II. Sphere or Globe

1. Here is a penny. It is, as you know, **circular in**

shape, and its diameter or through measure is the same from every part of the circumference.

. I am going to spin it on its edge on the table, and I want you to watch it as it spins.

What do you observe? **It looks like a solid ball.**

Place a smooth wooden ball of about the same diameter on the table, and spin the penny again by the side of it. The penny as it spins appears to be another round ball like that.

2. Let us look at this wooden ball now, and see what we can learn about it. Notice that if I drop it on the table, **it rolls evenly and smoothly** like the wheel, without any jolting, but that unlike the wheel **it will roll in any direction**, and not one way only.

Roll an egg on the table and compare the two.

Why does the ball roll so smoothly? Let us see.

3. *Produce the other ball which has been cut in halves through the centre, and show that* **the cut surfaces are two perfect circles of exactly the same size.**

As they are circles, **every diameter** we could draw across them **would be the same length**, and **every part of the circumference is exactly the same distance from the centre.**

Point out also that wherever we might cut the ball across (provided we cut it through the centre) we should get circles of exactly this size, and in this way lead the children to see

(*a*) That **every line which passes through the centre** from one side of the ball to the other is a **diameter of the ball.**

(*b*) That **every part of the surface of the ball** (like every part of the circumference of a circle) **is the same distance from the centre.**

4. *Tell that we call a perfectly round ball of this kind* a **sphere** or **globe.**

The ball rolls evenly and smoothly because it is a

sphere, and every part of its surface is the same distance from the centre.

III. Round like an Orange

1. *Produce the orange now, and after pointing out that this is a sort of round ball, pass a sharp knitting needle through it, in the direction of the stalk.*

We are going to measure through the centre of the orange with the needle. What is the name for this through measure? The **diameter.**

Draw the needle out and carefully note the measurement, and then pass it through again at right angles to this.

What shall we call the measurement through the orange this time? **This is a diameter too.**

Remove the needle and carefully compare the two measurements.

Let the children observe for themselves that the diameter in the direction of the stalk is less than that in the other direction.

Elicit that the orange is not a perfect sphere, **because one of its diameters is shorter than the others.**

2. *Now call closer attention to the actual shape of the orange, and lead the children to point out the reason for this.*

That part of the orange where it was joined to the stalk, and the part exactly opposite to this, are **not round like the other parts**; they are both **flattened.** Hence **the diameter between these two flattened parts is shorter than any other.** The orange is a sphere **flattened at two of its opposite ends.**

3. *Tell that* **the earth is like an orange in shape,** *for it is flattened at two of its opposite parts, and therefore one diameter is shorter than the others, and* **it is not a perfect sphere.**

We say the earth is round like an orange.

These flattened parts on opposite sides of the earth

are called **the poles,** and as they are at the extreme north and south of the great ball, we call one **the North Pole** and the other **the South Pole.**

IV. The School Globe

1. *Remind the children in the next place of the ball which was used in the preceding lesson, and elicit again that our earth is a great ball, and that we walk about on the outside of it just as a fly might walk about on the surface of this ball. Then proceed as follows:—*

Let us imagine a fly to be standing on the ball now. It could walk about all over its surface wherever it pleased.

Can we walk about wherever we choose on any part of the surface of our great ball? No.

Why not? Because **the earth is made up partly of land and partly of water,** and we cannot walk on water.

2. *Introduce the school globe now and continue:—*

This ball is a model of our earth. We call it **the globe.** Look at it carefully as I turn it round. It is not a plain ball like the one we used in our last lesson. There is something marked all over its surface.

Does it remind you of anything you have seen before? **It looks like a map.**

Quite right, it is a map. The whole of the surface of the globe is covered with a map, and as this map shows us the position of all the land and all the water in the world, **it is a map of the whole world.**

3. *Remind the children that, as this globe is a model of the earth, it ought to show us the position of the North and South Poles which we spoke of just now.*

Point these out, and then lead the children to tell that, if we know the north and south of any map, we also know where to find the east and west.

Let them point out the east and west on the globe.

This map of the world, like all other maps, **tells us everything we want to know about direction.**

4. *Now measure with a tape round the middle of the globe, and stretch out the tape to show the measurement.*

Who can tell me what name to give to this measurement round the globe? The **circumference.**

Explain that this length of tape—which tells us the circumference of the globe—*represents* **25,000 miles on the earth itself,** *for we have already said that the earth is* 25,000 *miles round.*

Look at the piece of tape, and think of 25,000 miles. What does it teach us? It teaches us that this globe and the map which covers it, **must be made on a very small scale.**

5. *Point out in the next place that, as the world is made up of land and water, our first step in trying to understand this globe and the map on it must be to learn how the land and the water are represented.*

Let the children find this out for themselves. With a good relief globe they will have no difficulty, because the variety of colouring and the raised contour of the land are in marked contrast with the one general colour and the level surface of the water.

6. *Elicit that these raised parts of the land represent mountains—some of which tower upwards to the height of several miles; and yet notice* **how little they interfere with the general roundness of the globe.**

Remind the children that the globe is a model of the earth itself, and explain that **the highest mountains in the world are really so small, compared with the enormous size of the great ball,** *that they interfere no more with its round shape than these raised parts do with the roundness of the globe.*

7. *Show the orange again, and call attention to the roughness of its outside skin.*

Its surface is everywhere full of little hills and hollows, but these do not interfere with its shape, because they are so small compared with the size of the orange.

Explain that it is just so with the mountains and valleys on the surface of the earth. They are no more, compared with the size of the immense ball itself, **than the little hills and hollows are on the rough skin of the orange.**

V. Meaning of Up and Down

1. *Turn once more to the globe—the model of the earth. Lead the children to imagine some tiny little people, ever so small, walking about on it, just as we ourselves walk about on the earth.*

Their feet, of course, would rest on the globe, and their heads would be in the air.

Imagine some of those same little people to travel round the globe till they came to the under part of it.

How could they stand and walk about then? They would still stand with their feet on the globe, and their heads away from it.

Then, of course, **their heads would point in the opposite direction** to the heads of those people they left behind.

Show that this must be so, and point out that what is true of this little globe must be equally true of the great globe on which we live.

2. People live in all parts of the world, and those in lands on the opposite side of it to ourselves **actually walk about with their feet towards our feet,** and **their heads pointing in the opposite direction to ours.**

Tell that we call these people our **antipodes,** *from a Greek word which means that* **their feet are against ours.**

3. But are those people hanging head downwards? Are they in danger of falling off? Let us see.

You have often seen stones and other things fall. Which way do they always fall? **Towards the ground.**

Everything that falls, falls to the ground. We say the things fall **down to the ground.**

Give one of the children a heavy object of some kind to hold in his hand, and lead him to tell that **the weight presses on his hand,** *and* **forces it towards the ground.**

4. *Tell that it is precisely the same in every part of the world.* A weight held in the hand presses the hand towards the earth wherever we may be. We say it presses down, because **down means towards the earth,** and **up means in the opposite direction, towards the sky.**

Our antipodes walk **with their feet downwards** towards the earth, and **their heads up towards the sky,** just as we do.

Summary of the Lesson

1. A sphere or globe is a perfectly round ball. Its diameters are all the same length, and every part of its surface is exactly the same distance from its centre.
2. The earth is a sphere flattened at two opposite points. We say it is shaped like an orange.
3. These flattened parts of the earth are called the North and South Poles.
4. The school globe is a model of the earth. The map on it shows the position of all the land and water in the world.
5. Our antipodes live on the side of the earth opposite to us. They walk about with their feet towards our feet. Their heads and ours point in opposite directions.

THE EARTH AND ITS MOTIONS

Lesson XXVII

THE EARTH'S DAILY MOTION

The school globe, and a large lamp fitted with a plain, round, opal shade, will be required.

I. Introduction

1. *Commence with a brief reference to the early lessons on the sun. Lead the children to tell that, when they first get up in the morning, they see the sun low down and in the east, that it mounts higher and higher in the sky till noon, and that during the afternoon it sinks little by little, and at last disappears altogether in the west.*

How would you describe this course of the sun across the sky? The sun **seems to travel** across the sky **in a curve or arch** from east to west.

What do we say the sun does every morning and every evening? We say **it rises in the east** every morning, and **sets in the west** every evening.

What is the most curious thing you remember about all this? The most curious thing is that **the sun never moves at all. It is the earth that moves.** (N.B.—*This much was told in the early lessons.*)

Quite right. Day by day the sun makes its first appearance in the east, we watch it in different parts of the sky during the day, and we at last see it disappear in the west, and of course we think it has travelled across the sky. But instead of that it is the earth itself which is moving in the opposite direction—**from west to east.** The sun is quite still—it does not move at all.

2. Do you ever make the same sort of mistake yourselves, and fancy you see the trees and houses moving? Yes.

When? When we are riding in a railway train.

What do you observe then? As the train goes along, the trees, hedges, houses, and telegraph poles seem to rush past the carriage window the other way.

But in spite of what you see, you know that in reality **it is the train which is moving**, and not the houses and trees, for they are fixed in the earth.

How can we account for our mistake then? Let me explain.

The train in which we are riding goes so rapidly and so smoothly that we do not notice, for the moment, that we are moving at all, and **the trees and other things seem to be flying past us in the opposite direction**, although we know they are fixed in the ground and cannot move.

3. N.B.—*A vessel of some sort—say a small yacht—sailing down a smooth stream affords an even better illustration of this phenomenon than a railway train*, **because of the entire absence of all rumbling and jolting.**

It glides along so smoothly that it would be almost impossible for a person seated in the cabin to tell that he was moving at all. But if he looked out of the cabin window, he would see the trees and other objects on the bank apparently **flying past him up the river,** *and that would be sufficient to tell him that, in reality, he was moving* **down the river in the opposite direction.** *Describe this experience and proceed*:—

4. Our observations from the railway train and from the boat will help us to understand what is really going on, when we watch the sun day by day.

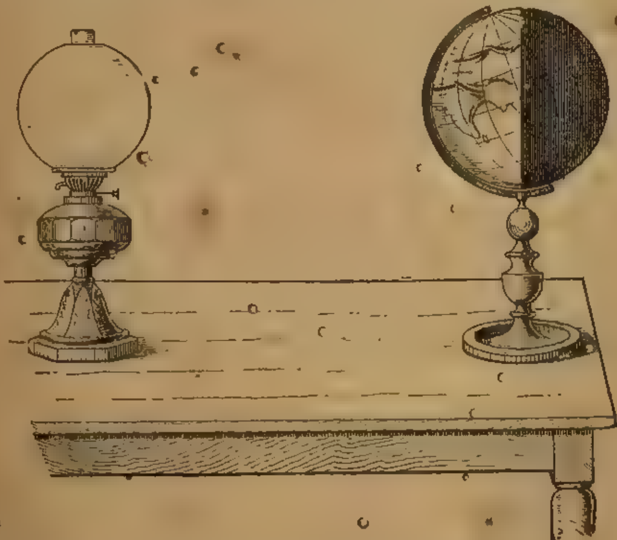
We are riding on the earth, **but the earth moves so rapidly and so smoothly** that we do not know we are moving at all. The sun seems to us to travel across the sky from east to west every day, but the truth is the sun never moves at all—**it is the earth which is moving from west to east.**

I once promised to tell you how this all happens. Let us see what we can learn about it now.

II. The Earth Turns Round on its Axis

1. *Introduce the school globe, remind the children that it is simply a model of the earth, and ask them to point out the extreme north and south parts of it.*

What names did we give to these two opposite parts of



the globe? **The North and South Poles.**

Set the globe revolving, and notice how easily it turns.

It seems made on purpose to turn round like this. **It turns on these two little pivots,** one at the north pole, the other at the south pole.

2. *Now stand the globe at one end of the table, and the lighted lamp (on a level with it) at the other end, and at the same*

time darken the room as much as possible during the experiments by drawing down the window-blinds.

Call upon the children to observe that the light from the lamp **can shine on only half of the globe at one time** *—that the side farthest from the lamp is in the shadow. Proceed as follows:—*

3. Let us imagine for a moment that this globe is ever so much bigger, and that there are some tiny little people living on it—say just in this spot. They would not be able to see the lamp from where they are, but notice what happens when I begin to move the globe slowly round from west to east.

As it turns round, point out that those imaginary little people on it would first catch sight of the lamp **peeping up above its curved surface in the east.** *It would seem to them to be coming into view from that direction.*

4. *Continue to move the globe round, and show that the lamp (although we know it to be fixed in the same spot) would appear to them to move more and more into view, until it was opposite to them* —**almost over their heads.**

Move it still further round towards the east, and point out that **the lamp would now seem** *to those little people* **to be passing away from them towards the west,** *and at last* **it would disappear from their view altogether.**

Go with the little people for the remainder of their journey through the dark shadow, until they get another first glimpse of the lamp, **as it seems to come towards them from the east once more,** *and show that the same thing would be repeated again and again every time the globe turned round.*

5. *Notice that the curious part of it all would be that, if the globe moved round smoothly without any stopping or any jolting,* **our little people would feel nothing of their own movement.** *They would see the lamp coming and*

going time after time, and of course they would very naturally think that it was the lamp moving and not themselves.

Now let us see what we can learn from all this.

The globe is a model of our earth; it represents our earth, and those supposed little people on it are ourselves.

The lamp of course represents the sun, and you must remember that **the sun stands as still as our lamp did**; it never moves.

This globe is made on purpose to turn round, so is our earth, although **it has no need of pivots** at the North and South Poles. It can turn without them.

We say that **the earth turns round on its axis,** and by the axis we mean **an imaginary line through the centre of the earth from one pole to the other.**

As the earth is constantly turning round on its axis from west to east, **the sun appears to us** (as the lamp would appear to the little people on the globe) **to travel in the opposite direction** from east to west.

III. Day and Night

1. *Remind the children that the lamp was only able to light up half the globe at one time—that the other half was in the dark shadow, and tell that it is exactly so with the sun. It can only shine on one half of the earth, and when it is shining on that half*, **the other half is in darkness.**

Explain that from the time we get our first glimpse of the sun in the east to the time it disappears in the west, **it is shedding its light and heat on us**; *and from the time when it disappears to the time when we see it again*, **we are in darkness and coldness.** (*Sketch this on the black-board.*)

2. Part of our lives then is spent in light and part in darkness.

What name do we give to these times of light and darkness? We call the light time **day**, and the dark time **night.**

Now think of this and see if you can tell me how long it takes our earth to turn round once on its axis. What do you say? It must **turn round once every twenty-four hours.**

Quite right. We speak of this as **the daily motion of the earth.** It is this daily motion which gives us **day and night.**

3. In our last lesson we spoke of our antipodes. Who are they? The people who live on the other side of the earth, and **walk about with their feet opposite ours.**

Now I want you to think over what you have just learned, before you answer the next question. Are those people walking about now? No.

Why not? Because they live on the other side of the earth, and as it is day here, **it must be night there. They are asleep in bed.**

4. *It would be well, before closing the lesson, to lead the children, with the help of the globe and the lamp, to explain what would happen if the earth did not move round in this way.*

One half of the earth would be always facing the sun, the other half would be away from it. One half would get all the sun's light and warmth, the other half would **get none.**

5. *Remind the children of the importance of sunlight and warmth, both to ourselves and the other living creatures on the earth, and also to plants, and lead them to tell what would be the effect of this.*

That side of the earth which received none of the sun's light and warmth would be in eternal darkness and cold—**an ice-bound world in which neither man, nor animals, nor plants could live.**

The other side, with the sun constantly shining on it, would be as unfit to live in because of the heat; **it would be so scorched up that nothing could live there.**

Show from this that the earth, by constantly turning round on its axis day after day, brings light and warmth to every part in its turn—**no part is entirely without the sun, no part is scorched up** *during the whole of the twenty-four hours.*

Summary of the Lesson

1. The earth spins round on its axis as a top spins round on its peg.
2. It takes twenty-four hours to spin round once. We call this the earth's Daily Motion.
3. It always spins round in one direction—from west to east.
4. The sun does not move; it remains fixed.
5. As the earth spins round from the west, the sun comes into view in the east, and at last disappears in the west. This is why we say the sun rises in the east and sets in the west.
6. As the sun can shine on only one half of the earth at one time, that part is lighted up, and the other half is in darkness.
7. In the part that is lighted up it is Day; in the other part it is Night.

Lesson XXVIII

THE EARTH'S YEARLY MOTION

Have in readiness a boy's top and string, a yellow ball, the school globe, and the lighted lamp of last lesson. Brown's Pictures of the four Seasons will be useful.

I. The Earth travels round the Sun

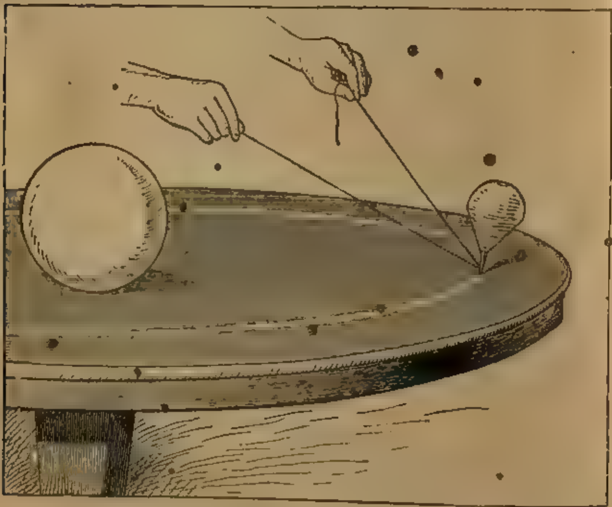
1. *Spin the top (or let one of the boys spin it) and place it spinning on the table.*

Refer to the subject of the last lesson, and lead the children

to tell that the top, as it spins, reminds them of the earth spinning round on its axis.

After eliciting a few of the leading facts about this daily motion of the earth, spin the top again, and while it is spinning throw the string over it, and draw it across the table.

2. *Lead the children to tell from what they observe that* **the top is now moving in two ways.**



It is not only **spinning round and round on its peg,** but it is also **travelling across the table.**

Explain that the same thing happens when we throw a ball up into the air. The ball **whirls round and round** on its axis, and at the same time **travels through the air.** It moves with **two motions.**

3. *Tell that the earth, like the top and the ball, has two motions.*

It turns round on its axis **once every twenty-four**

hours, and it also **travels round the sun along a path of its own**, which we call its **orbit.**

N.B.—*It is needless to observe that the exact shape of the orbit, and the exact position of the sun within it, are details which can well be dispensed with at this stage.*

Mark out on the table a chalk line for the orbit, and place the yellow ball within the figure to represent the sun. Tell, of course, what has been done, and then, without any further explanation, spin the top once more, and endeavour to draw it by means of the string, as far as it will go, along the chalk line.

4. *Point out that the top is not only* **travelling along the chalk line,** *but it is at the same time constantly* **spinning round on its peg,** *and proceed:—*

This will give you some idea of the way in which the earth travels along its orbit in its journey round the sun. It takes **exactly a year** to complete its journey, and we speak of this as **the earth's yearly** or **annual motion.**

How many times would it turn round on its axis while making this journey? Three hundred and sixty-five times.

Why? Because there are **365 days in a year.**

II. Summer and Winter

1. *Remind the children once more that day by day the sun seems to move in an arch across the sky from east to west, and lead them to tell that it reaches its highest point at noon.*

Elicit in the next place that it is not at the same height in the sky every day in the year at noon; that it mounts **much higher in the summer** *than in the winter.*

Lead them also to tell that it **rises earlier** *and* **sets later** *in the summer than in the winter—that* **the summer days are long, the winter days short.**

Tell that these are the two very reasons why there is so much difference between summer and winter.

2. The weather is warmer in the summer than in the winter, because the sun then rises earlier and sets later—**it is seen and felt longer.** We get long days and short nights; and as it also mounts higher in the sky **it has more power to warm the earth** while it is shining.

When it rises late and sets early, we get **long nights, short days,** and **very little sunshine,** and even at noon it is so low in the sky that **it has not much power to warm the earth**; the earth gets cold, and then we have **winter.**

III. The Earth's Axis

1. *Spin the top once more, and as it spins call attention to the peg on which it turns. Point out that if the peg ran right through the top it would be something* **like the axis of the earth**—*that imaginary line through the centre from pole to pole,* **except that the earth spins round without any peg at all.**

Notice that as the top spins it is perfectly upright—its axis is upright, and then introduce the school globe and set it revolving.

Ask the children to tell where the axis of the globe is. It is **that supposed line between the two poles on which the globe turns.**

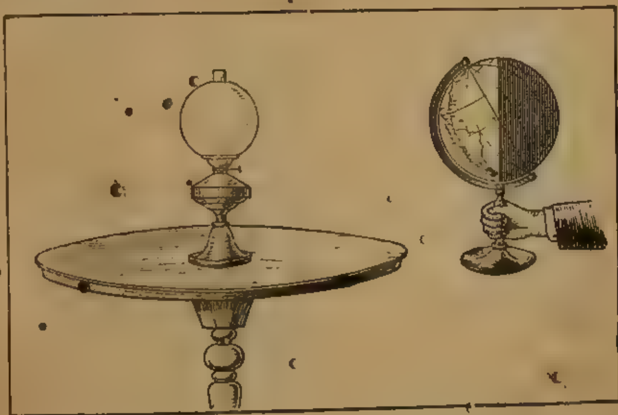
Compare it with the axis of the spinning top, and lead them to tell that, instead of being upright, **it is slanting.**

Remind them that the globe is only a model of the earth, and tell that **the axis of the earth** *in like manner is* **slanting**—*not upright.*

2. *Now light the lamp, and place it at one end of the table* (i.e. *on the children's left*), *with the globe at the other end* (*on the children's right*). *Stand the two in such a position that* **the north end of the axis of the globe slants towards the lamp,** *and of course the lamp should be placed so that it may shine on the middle of the globe.*

N.B.—*It would be well here, as in the former lesson, to darken the room during the experiments as far as possible by drawing down the window-blinds.*

Set the globe revolving slowly now, and lead the children to tell from what they observe that, while it is in this position, **the northern part of it gets more of the lamp's light than the south.**



3. The northern part is **longer in the light than the south,** and the southern part is **longer in the shade than the north,** every time the globe turns round.

Remind the children that the globe of course represents the earth, and the lamp the sun, and tell that, when the earth is in this position, **the northern part of it gets more sunshine than the south,** *and therefore it is* **summer in the north** *and* **winter in the south.** *(Sketch this on the black-board.)*

Now move the globe slowly round the lamp till it comes to a position exactly opposite, taking care **to keep the axis still slanting in the same direction,** *and remembering that the globe must pass behind the lamp—not between it and the class.*

Lead the children to tell that this represents the earth travelling in its orbit round the sun.

4. How long does the earth take to complete its journey round the sun? **A whole year.**

How much of its journey has this globe completed since it started? **Exactly half.**

How do you know? Because it is exactly opposite

where it was when it started; **it is on the opposite side of the lamp.**

Then if we call the globe the earth, and the lamp the sun, how long would it have taken the earth to reach this position? **Exactly half a year.**

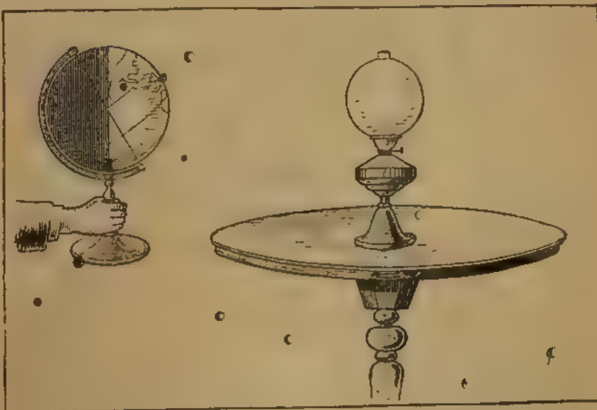
Quite right. The earth takes exactly half a year **to travel from one side of the sun to the opposite side.** Now let us see what has happened meanwhile.

5. *Call attention to the axis of the globe in the new position, and lead the children to point out that* **the northern end of the axis,** *instead of slanting towards the lamp, as it did on the other side,* **now slants away from it.**

Set the globe revolving slowly as before, and let the children observe for themselves, and tell that **the southern part of it now gets more of the light** *from the lamp than the north.*

6. In this position **the southern part is longer in the light** than the north, and **the northern part is longer in the shade** than the south, every time the globe turns round.

Lead the children to tell, from what they already know, that



when the earth is in this position **the southern part of it gets more sunshine** *than the north, and therefore it is* **summer in the south** *and* **winter in the north.** (*Sketch this on the black-board.*)

What name do we give to those people on the other side of the world who walk about with their feet opposite ours? We call them our **antipodes.**

What name do you think they would give us? They would call us **their antipodes,** because our feet are opposite theirs.

Then let us suppose that the people in the northern part of the world are in the midst of winter with its frost and snow and short dark days. What kind of

weather will their antipodes be enjoying? **Warm summer weather, with long, bright, sunny days.**

And at the very time when their winter comes what is our weather like? **Bright, warm, summer weather.**

7. *It will amuse the children to learn that, in the southern parts of the world,* **Christmas Day comes in the middle of summer,** *and that the people there keep it in the warm,*

sunny, open air, and not, as we do, sitting round a cosy fire, with the snow perhaps falling outside.

As we have not yet shown the position of England on the globe, this would be a good opportunity for eliciting, from what has been said already, that **it must be somewhere in the northern part of the world.** *It would be best, however, to say no more of this for the present.*

IV. Spring and Autumn

1. What name do we give to that part of the year between winter and summer? **Spring.**

And what do we call the other part of the year between summer and winter? **Autumn.**

What can you tell me about the weather at these times? It is **not so warm as it is in summer, nor so cold as it is in winter.**

Are the days longer or shorter in spring than they are in winter? **Longer.**

How do you know? Because it is hardly daylight when we come to school in the winter, and it is dark

before we get home; but when the spring comes **we begin to get our breakfast and tea without a light,** and every day **the light lasts a little longer** than it did the day before.

2. Now think of the autumn. Are the days longer or shorter then than they are in summer? **Shorter.**

How do you know? Because we see the men come round **a little earlier** every week **to light up the street lamps in the evening;** we cannot play so long after school, because it gets dark sooner, and after a time we

begin **to want a light when we first get up in the morning.**

3. *It would be well after this to move the globe round midway between the positions for winter and summer, still keeping the axis pointing in the same direction.*

Too much, of course, must not be attempted with this, but it will be easy to show that, in this position, which represents the earth in the middle of spring, **north and south get an equal share of the sun.**

Tell that in mid-spring we get **twelve hours day and twelve hours night,** *and show, with the help of the globe, of course, that it is* **exactly the same in autumn.** *(Sketch on black-board as before.)*

Spring is simply the **change from winter to summer;** autumn is a similar **change from summer to winter.**

Summary of the Lesson

1. The earth travels in its orbit round the sun once every year. This is the earth's Annual Motion.

2. The earth's axis is not upright: it points in a slanting direction.

3. When the north end of the axis slants towards the sun, it is summer in the northern part of the world and winter in the southern part.

4. When the south end of the axis slants towards the sun, it is summer in the southern part of the world and winter in the northern part.

5. Spring is only the change from winter to summer; autumn is the change from summer to winter.

Lesson XXIX

EARTH, SUN, MOON, AND STARS

I. Introduction

Let us commence our lesson to-day by thinking over what we have been learning lately about the earth and the sun.

What is our earth like? It is **a great globe** or ball.

What is the most curious thing you have learned about this ball? It is always on the move. **It is never still.**

How does it move? **It spins round on its axis** like a top once every twenty-four hours, and **it travels round the sun** in the same path once every year.

Now think of the sun. What can you tell me about that? The sun is a great ball too. It is **a great ball of fire.**

Have you ever seen anything else in the sky that looks like a ball? Yes, **the moon.**

Quite right. The **earth,** the **sun,** and the **moon** are all great balls, and so are **all those little stars** which shine so brightly in the sky.

Let us see what we can learn about all these great balls now.

II. The Sun

1. *Lead the children, in the first place, to describe* **the**

brightness of the sun. *It is so bright that we cannot look at it for long together.* **It dazzles our eyes,** *so that we cannot see other things clearly afterwards.*

Remind them that when we look at the sun we are really **looking at a blazing furnace of fire.**

Notice, in the next place, that the sun, as it appears to us, **looks no bigger than a common football,** *and then tell that, in reality, it is so large that it would take* **more than a million balls like our earth to make one ball as big as the sun.**

2. *Remind them that our earth measures 25,000 miles round, and is nearly 8000 miles through from one side to the other, and so lead them to think what an immense ball the sun must be.*

Why then does it look so small? **Because it is a long way off.**

Yes, it is a long way off—much too far off for us to really understand.

It is about **ninety-two millions of miles** from our earth to the sun. But of course you cannot think what that means.

Let me see if I can help you to understand it. Suppose it were possible to send a railway train travelling at the rate of 50 miles an hour from the earth to the sun.

How long do you think that train would be in reaching the sun if it never stopped for a moment? It would have **to keep on travelling at the same rate night and day more than 200 years.**

3. My next question about the sun you can all answer. We see it travelling across the sky from east to west every day of our lives, but we have learned that it is not wise to believe everything our eyes tell us.

What do I mean? **The sun is really fixed, and does not move at all.** It is our earth that moves.

4. Now last of all. What use is the sun to us? **It**

gives light and heat to the earth. Without the sun there could be **no life** on our earth. Neither **plants** nor **living creatures** of any kind could live without it.

III. The Earth

Suppose we have one more thought about our earth next. It is, as we just now said, more than a million times smaller than the sun, and this means that there is more difference in the size of these two balls than there is between a dust-hill and a mountain.

1. What would you think if you were told that this earth of ours was once **part of the blazing burning sun?**

Yet it is quite true. A tiny fragment of that immense ball of fire **was once thrown off** blazing and burning like the rest. **That tiny fragment is the great earth** on which we live. It has been cooling ever since, but it is **only the outside of this ball which is cool** even now. The inside of it is still **a raging furnace of fire,** like the sun from which it came.

*As an illustration of this, remind the children of what was taught in connection with the cooling of the lava from **volcanoes.***

2. *Anticipate the next question which will naturally arise in the mind of an intelligent child:—*

If this fragment was thrown off from the sun, why does it still continue to travel round the sun year after **year?**

Remind the class of the power which a magnet has of **drawing and holding another smaller magnet,** *and tell that* **the sun has a power something like this** *of keeping the earth close to itself,* **so that it cannot get away.** *Illustrate this by setting one of the boys to whirl a cap, tied up like a ball at the end of a string, round and round his head.*

The earth is like the cap; it keeps whirling round the sun; it cannot get away, although there is no string to hold it. **The sun draws or attracts it** in some such way as one magnet draws another. **This is why it travels round the sun** year after year as the boy's cap travels round his head.

3. *Tell that because the earth travels round and round the sun in this way we call it* **a planet.** *The word* **planet** *means* **a traveller** *or* **a wanderer.**

Remind the children now of the ball thrown up into the air. It moves with a double motion—**it whirls round and round** *on its axis, and* **it travels through the air,** *and elicit that this is exactly the way in which our earth travels.*

4. *Explain that it is this whirling motion round and round on its axis, which* **has given the earth its round orange-like shape,** *flattening it at the poles and swelling it out between them.*

Tell, in illustration of this, that if a ball of soft, wet clay were made to spin round and round very rapidly, **it would become flattened at the poles,** *and* **swollen out midway between them.**

This might be shown experimentally by pushing a round stick through the ball of wet, soft clay, and then trundling it as a sailor trundles a mop.

Point out that when this fragment of burning matter (which forms our earth) was first thrown off from the sun it was **without form and void,** *but it was also* **as soft as wet clay.**

It is this whirling motion of the earth on its axis which **has flattened it in one direction**—at the poles—and **swollen it in another**—midway between.

IV. The Moon

1. Let us now turn to the moon—another of these great globes or balls.

The moon, as you know, shines at night when we have lost sight of the sun.

Can you tell me why it does not shine in the day-time? **It does shine then,** as well as at night; but we cannot see it, **because of the strong, bright light of the sun.**

What kind of light does the moon give? A **soft, white, silvery light.**

Does it dazzle our eyes to look at the moon, as it does when we look at the sun? No, we can look at the moon without blinking.

Explain the reason for this. Tell that **the moon is not a blazing, burning mass** *like the sun. It has* **no light, no heat** *of its own. The sun shines on the moon, and* **the moon reflects** *or* **throws back the light,** *so that the moon shines with light,* **which it borrows from the sun.**

Tell that sometimes **the sun lights up only a part of the moon's surface.**

We cannot see the whole of the ball then, **because the moon itself is dark,** and has no light of its own. At other times the sun shines full on the moon, and then **the whole round ball can be seen.**

Elicit, in the next place, that the moon and the sun look to be about the same size when we see them in the sky, and then tell that in reality the moon, so far from being as big as the sun, **is very much smaller than the earth itself.**

2. The mass of the moon is only about one-eightieth part of the mass of the earth. That is, **it would take eighty balls as big as the moon to make one ball the same size as our earth.**

How is it then that the moon and the sun both appear to be about the same size? The moon must be much nearer to us than the sun is.

Quite right. The moon looks as large as the sun, **because it is so much nearer to us than the sun.** The sun **looks no bigger than the moon,** because it is all those millions of miles off.

3. *Lead the children to think again of the supposed railway train going at the rate of 50 miles an hour from the earth to the sun.*

If such a journey were possible, how long would it take to reach the sun? It would take the train **more than 200 years.**

Tell that the same train would traverse a distance as far as that between the earth and the moon in **less than 200 days.**

4. We spoke just now of the different appearance of the moon at different times. We will now try to find out the meaning of this.

In the first place, I must tell you that **the moon belongs to the earth,** just as the earth belongs to the sun, and as the earth travels round the sun, **so does the moon travel round the earth.**

What do we call the path in which the earth travels round the sun? The earth's **orbit.**

How long does the earth take to complete its journey round the sun? Exactly a year.

Why does the earth always keep the same path round the sun? Because the sun has the power to draw and hold the earth, so that it cannot get away.

Now tell that **the earth has the same power over the moon,** *as the sun has over the earth.* **It holds the moon so that it cannot get away.**

The moon travels round the earth in its own path or orbit, but **it completes its journey in four weeks** or twenty-eight days.

5. *Explain that when we speak of* **a month** *we mean the time* **the moon takes to go round the earth.**

Remember, then, as the earth travels round the sun it carries the moon along with it, **but the moon itself is all this time travelling round the earth once every four weeks.**

Illustrate this by a sketch on the black-board, and, referring to the sketch, point out that as the moon travels round the earth

it must sometimes come between us and the sun. Show it in this position.

6. The sun at such times shines full on one side of the moon, **but that side is away from us.** We cannot see it; **we only look on the dark side of it.**

Now sketch it in other positions, one by one, as it passes from between the earth and the sun, and travels round in its orbit.

Show that at first the sun lights up only **a narrow streak**

or **bow on the edge of the moon,** *and that this narrow streak* **gradually widens** *and spreads, until, at last, when the moon is halfway through its journey,* **the whole face of it is lighted up.**

Trace it and sketch it through the other half of the journey, and in this way make clear the terms—**new moon, first quarter, full moon, last quarter,** *and so on.*

V. The Stars

It is not necessary to dwell at any length on this part of the subject. But it will interest the children to learn that **every star** *they see in the sky* **is an immense ball,** *like the great globe on which we live, and that nearly every one of them is larger than our earth—some of them many many times as big.*

Why then do they appear so small to us?

Tell that most of the stars are so far away from us that **even the sun,** *at its immense distance,* **seems to be quite near** *in comparison with them.*

Tell that some of the stars are **planets** *like the earth, and* **travel across the sky** *in orbits of their own; others are* **fixed** *like the sun, and do not move about.*

The **fixed stars** are those which **twinkle**; **the planets do not twinkle.**

SUMMARY OF THE LESSON

1. It would take more than a million balls like our earth to make a ball as big as the sun.
2. The sun is [illegible] millions of miles from our earth.
3. The sun gives light and heat to the earth. It is the source of all the life on our globe.
4. The earth travels round the sun, in the same orbit year after year, because the sun has the power of drawing and holding it, so that it cannot get away.
5. The moon has no light of its own. It borrows its light from the sun and reflects it to the earth.
6. The moon travels round the earth once in 28 days. The earth draws and holds the moon, just as the sun draws and holds the earth.
7. Some of the stars are fixed like the sun; others travel across the sky in orbits of their own.
8. These travelling or wandering stars are called planets.

THE SCHOOL GLOBE

Lesson XXX

HOT AND COLD LANDS

The school globe, the [illegible] and an orange will be [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

I. INTRODUCTORY

1. *[illegible] the school globe and call attention to the line which passes round the middle of it* **midway between the two poles**.

[illegible] the orange were cut through along this line it

... could be **divided into two halves,** *just as we divide an orange by cutting it across the middle.*

Divide an orange with a knife in illustration of this.

2. *Point out that each part would be* **half a globe,** *and then tell that we have another name—* **sphere** *—which means the same as* **globe.**

Tell that we call each of these halves of the globe **a hemisphere,** *because* **hemi** *means* **half,** *and* **sphere** *means* **a globe.**

Lead the children to notice that one half would represent all the northern part of the world, the other half all the southern part, and tell that we call one **the Northern Hemisphere,** *the other* **the Southern Hemisphere.**

3. This line you see round the middle of the globe **divides it into two equal hemispheres,** and now I want you to remember its name. We call this line the **Equator.**

II. The Torrid Zone

1. *Place the lighted lamp in the middle of the table [illegible] and let one of the children hold the globe [illegible] in the position which the earth occupies during the [illegible]. Darken the room for the experiment as before, by pulling down the window blinds, and then let the children see for themselves that, as the globe revolves on its axis,* **the lamp shines full on the Equator,** *and* **lights up the whole face of it from pole to pole.**

2. *Move the globe now into the summer position for the Northern Hemisphere, taking care to see that* **the North Pole points towards the lamp,** *and set it revolving as before. There should be no reference to the earth throughout these experiments. We are at present dealing with the lamp and the globe alone.*

Lead the children to observe and tell that **the lamp now lights up more of the Northern** *than the Southern Hemisphere—that, in fact,* **the whole of the North Pole is in the light,** *and* **the whole of the South Pole in darkness.**

3. *Point out the reason for this.*

The lamp does not shine directly on the Equator now, but some distance to the north of it, and therefore its **light cannot reach so far south as the South Pole,** because it can only shine on half the globe at one time.

Mark on the globe the part which is exactly opposite the lamp now.

4. *Let the boy with the globe pass round next into the autumn position—still taking care to see that* **the axis is pointing in the right direction.**

The children will have no difficulty in recognising that, in this position, **the whole face of the globe, from pole to pole, is lighted up again,** *as it was in the position opposite to this. Lead them to tell why.*

The lamp shines now, as it did then, **directly on the Equator.**

5. *Lastly, place the boy with the globe to represent the winter position, and lead the children to tell what they observe.*

The lamp now shines **more on the Southern than the Northern Hemisphere.** It lights up the whole of the South Pole, **but the North Pole is in darkness.**

Elicit the reason this time instead of giving it.

The lamp does not shine directly on the Equator, but some distance to the south of it, and **it cannot reach so far as the North Pole,** because it can only shine on half the globe at one time.

Mark on the globe the part which is exactly opposite the lamp in this position.

6. Now let us see what we have learned from all this.

The lamp, of course, represents the sun; the globe, as it moved round the lamp, represented our earth travelling in its orbit round the sun.

Our experiments have shown us the positions of the earth with regard to the sun, when it is **spring, summer, autumn,** and **winter** in the Northern Hemisphere.

N.B.—*Point out and explain that for the seasons in the Southern Hemisphere the positions would be reversed, because it is winter there when it is summer in the north, and vice versa.*

7. We saw that, in all four positions, the lamp was either **exactly opposite the Equator itself, or some point north or south of the Equator.**

Now imagine this globe to be our earth, and the lamp the sun, and picture to yourselves some tiny little people walking about just here. Their feet, of course, would be on the earth itself; but where would their heads be? They would be **pointing to the sky.**

Then where would you expect to see the sun, if you were walking about with them? **Exactly overhead.**

8. *Point out that there, as in other parts of the world, the sun rises in the east, seems to travel across the sky in an arch, and sets in the west; and then explain that everywhere between those two marks which we made on the globe, the arch along which the sun seems to move* **passes almost directly overhead all through the year,** *and* **at certain times in the year the noon-day sun is absolutely overhead.**

9. *Point out carefully the result of this.*

When the sun shines directly overhead, **everything is in the full glare of its light and heat,** for no wall can cast a shadow, and the trees can only shade the ground which is directly covered by their branches and leaves.

Contrast this with our own experience here in England at noon on Midsummer day, June 21. Point out that **on this**

day the sun is higher in the sky at 12 o'clock *than on any other day in the year, and yet, if it is too warm,* **we can always find a shady spot,** *because the sun even then shines* **in a slanting position from the south,** *and not straight down on our heads, and* **it must, therefore, cast shadows** *towards the north.*

10. *Tell that in all those parts of the world on and near the Equator* **the sun scorches like fire,** *and there is nowhere any shelter from it.*

Make a sketch of the globe on the black-board, and call attention to the two lines, one north of the Equator, the other south of it.

These two lines are **circles** which we draw round the globe to show that, in all places which lie between them, the sun shines **either directly,** or **almost directly, overhead** all through the year.

The name **'tropics'** *may be given, but it is not necessary to trouble the children at this stage with the distinctive name of each circle.*

Explain that the word **tropic** *means* **'a turning,'** *and point out that the sun never shines exactly overhead beyond these two circles. When it reaches them it turns.*

We call all this part of the world between these two circles the **Torrid Zone.**

The word **torrid** means **scorching**; **zone** is only another name for **belt.**

Cut a strip of paper and place it round the globe to show what is meant.

This strip of paper is **a sort of belt going round the globe.** *It represents to us that all this part of the world is* **a scorching, burning region**—*the* **Torrid Zone.**

III. The Frozen Zones

1. *Show the globe and lamp once more now in the two positions for summer and winter, and point out carefully that in each case there is a large circle round one or other of the poles, which is completely in the shadow.*

The lamp shines all over one of the circles, but it cannot reach the opposite one, and therefore **that one is in the shadow.**

2. *Remind the children that the globe represents the earth, the lamp the sun, and with the help of a black-board sketch, and what the children have just seen, proceed to elicit, point by point, as follows:—*

(*a*) That when the sun shines directly overhead north of the equator, it is summer all over the Northern Hemisphere, and **winter in the Southern Hemisphere.**

(*b*) That the sun then shines upon the whole of the circle round the North Pole, and that **the other circle round the South Pole is in the shadow.**

(*c*) That day after day **the sun is never seen there.** *Let the globe revolve slowly from west to east to make this quite clear.*

3. *Now sketch again, with the sun below the equator, and lead the children to explain as before.*

(*a*) **It is winter now in the Northern Hemisphere,** and summer in the Southern.

(*b*) The whole of the **circle round the North Pole is now in the shadow**; the other round the South Pole is lighted up.

Elicit that in the middle of spring and in the middle of autumn the sun shines directly on the Equator, and reaches exactly as far as both poles.

Then explain that, round the North and the South Pole in turn, the sun begins to disappear after the middle of autumn, and **for months together it is never seen,** *till it begins to peep up above the horizon the next spring.*

4. *Point out, at the same time, that from spring till autumn (that is during the other half of the year), although the sun appears again,* **and the people, in fact, never lose sight of it day after day during the whole twenty-four hours,** *it is always* **very low down near the horizon.** *It has* **little power even then to warm the earth.**

Picture a region like this—entirely without sun for nearly six months of the year, and getting very little warmth from it during the other six months.

These are the regions of **eternal ice and snow.** We call them the **Frigid** or **Frozen Zones,** although the parts of the world which they cover are **more like great circles** than belts or zones.

IV. The Temperate Zones

1. *Elicit from the class that we live neither in a scorching, burning region, nor in a region of perpetual ice and snow—that in our land, England, the weather is* **never very hot or very cold.**

Place the paper belt round the globe to show the Torrid Zone, and two paper circles round the poles to show the Frozen Zones, and call attention to those parts which are left uncovered.

These form two great belts round the world. They are **nowhere so hot** as it is in the **Torrid Zone,** and **nowhere so cold** as it is in the **Frozen Zone.**

We call these two parts of the world the **Temperate**

Zones—one the **North Temperate Zone,** the other the **South Temperate Zone.**

2. *Point out now,* **for the first time, the position of England on the globe,** *and tell that all the great nations that have made the history of our world have belonged to this* **North Temperate Zone.** *The people of these temperate lands are* **more vigorous** *and* **more clever** *than the people who live under the scorching heat of the Torrid Zone, or those who have their home among the ice and snow of the North and South Poles.*

They can work better, and work is the very essence of life and success.

Summary of the Lesson

1. The Equator is a line supposed to be drawn round the middle of the earth to divide it into two equal parts.

2. We call one part the Northern Hemisphere, the other the Southern Hemisphere.

3. The Torrid Zone—all that part which lies between the two tropics—is the hottest part of the world. The sun scorches like fire.

4. The Frozen Zones are the parts of the earth round the North and South Poles. They are regions of eternal ice and snow.

5. The Temperate Zones lie between the Torrid Zone and the North and South Frozen Zones.

Lesson XXXI

MORE ABOUT LAND AND SEA

The school globe, and Brown's Picture of "The Races of Man," will be required. A good specimen of coral would be useful.

I. Introduction

1. *Introduce the globe, and lead the children to explain that it is a model of the earth, and that a map is drawn on it to show the position of all the land and all the water in the world.*

Tell that our next step will be to deal with the map which covers the globe.

Commence with a little chat about the land and water with the view to elicit that—

(*a*) We build our houses on the land, and make it our home.

(*b*) The plants which grow on it, the animals which live on it, and the minerals which are dug out of it provide us with materials for food and clothing, and everything we want for our use.

(*c*) The sea separates one part of the land from another, and when we wish to go to lands across the sea, we have to make a voyage in a ship.

2. *Pass on next to consider the extent of the land and water. Show on the globe that there is* **much more water than land.** *Tell that* **the water covers more than three-quarters of the earth's surface,** *and that* **less than one-quarter of it is land.**

Notice, too, that the water extends over the globe in all directions, **but the land lies in separate masses,** *large and small,* **in the midst of the water.**

Point out on the globe the largest of these masses of land, without, of course, mentioning any names for the present—Europe and Asia forming one, Africa another, Australia another, and America another.[1]

3. What name have we learned to give to **separate masses of land standing in the midst of the water?** Islands.

Yes, we might call them all islands, because they are

[1] The names will follow in due course.

all **surrounded by water.** But the largest of them are so very large that we give them another name.

Let us see now what we can learn about these very large pieces of land.

II. The Continents

Remind the children that we ourselves live on an island, and let them give its name, the names of the three countries in it, and the name of the sister island close by.

It was pointed out to them on the globe during the last lesson. Let them find it for themselves now, and then proceed as follows:—

Europe—

1. What name do we give to the larger land which lies near an island? We call it **the mainland.**

Look at the mainland near England. We gave that another name in one of our lessons.

Do you remember what it was? **A continent.**

Why did we call it a continent? Because it is so large that **it contains a great many different countries.**

Do you know the names of any of these countries? **France, Spain, Germany,** etc.

This continent has a name of its own. What is it? **Europe.** *Point it out on the globe.*

2. *Point out again the other great masses of land, and tell that they too are continents—they all contain a great many different countries.*

Tell that Europe, although one of the smallest, is **the most important of all the continents.** *The most important countries in the world are in Europe, and* **the people of these countries are wiser, cleverer, and better taught** *than the people in most of the other parts of the world.*

Our islands—**the British Islands**—*are part of Europe.*

Asia.—

1. *Notice, on the globe, that Europe occupies the western part of one of those great masses of land we pointed out just now, and tell that the part to the east of it is another continent, called Asia.*

Asia is the largest of all the continents. It contains **nearly one-third of all the land** in the world, and is the home of about **one-half of all the people** in the world.

2. *Point out that, like other continents, it contains a great many different countries, and show the two most important*—**India** *and* **China.**

Tell that these two great countries contain more people than any other two countries in the world.

3. The people of China are a very funny-looking race. They have **yellow skins** and **almond-shaped eyes,** which, instead of being in a line as ours are, **slant downwards** towards the nose. The men shave their heads, except on the crown, where they let the hair grow into **a long tail,** which is called their **pig-tail.** *Show the picture.*

Tell that, although they are very strange-looking, they are **very clever,** *and all of them are good scholars.*

Tell that the other great country—**India**—*although it is so far away,* **belongs to England**—*its people are the subjects of our King. Show the picture.*

Africa.—

1. *Point this out on the globe, and tell its name. It is another of the continents. Notice that* **the greater part of this continent lies within the Torrid Zone;** *that the whole of Europe and by far the largest part of Asia belong to the North Temperate Zone.*

Remind the children that in some parts of the world there are deserts of burning sand, and point out the **Great Desert,** *which takes up almost the whole of the northern part of this continent.*

2. *Tell that* **Africa is the home of the black people.**

Their **bodies are black** all over, they have **thick lips, flat noses, low foreheads,** and **short, thick, curly hair.** They are very savage and ignorant, and spend most of their time either in hunting the wild beasts or fighting with one another.

They do not build towns as we do, but **live in little low huts,** and **go naked,** or nearly so. These black people are called **negroes.** *Show the picture.*

3. *Tell that* **a very large part of this great continent now belongs to England,** *and we are trying to teach these poor, savage people to live better lives.*

America.—

1. *Show it on the globe, and point out that it consists of two great masses of land joined together by a narrow strip.*

What name shall we give to this **narrow neck of land** which joins these two great pieces together? An **isthmus.**

Point out that the part to the north of the isthmus is called **North America,** *that to the south of it* **South America.**

2. *Tell that* **America is the home of the red or copper-coloured people.**

We call them **Red Indians.** They are very fierce, warlike, and cruel.

Show the picture.

Explain, however, that most of the people in America now are white people like ourselves.

These people **left their homes in England** and other countries of Europe, and **went to settle in America,** and now they call America their home. But they are really **our own brothers and sisters,** and have no connection with the red men, who belong to America.

3. *Point to* **Canada,** *and tell that* **all this part of the great continent belongs to England.** *Its people own our King as their Ruler.*

Australia.—

1. *Point it out, and tell that* **this great island-continent,** *which is nearly as large as Europe,* **belongs to England.**

Most of the people who live in it now are our own countrymen—**people who have left these islands,** and gone to make a new home for themselves in Australia. But they are proud to call our King their King.

2. *Tell that, when we speak of our* **antipodes,** *we mean* **these very people who live in Australia, and the islands near it,** *and point out, on the globe, that they must walk about with their feet against ours, and that their heads and ours must point in opposite directions.*

III. The Oceans

The Atlantic Ocean.—

1. Let us come back home now to our own islands. Here they are. They are surrounded, as you know, on all sides by the sea, and the sea on the different sides of them takes different names.

Elicit the names of some of these, and have them pointed out on the globe.

Now look at this wide, open stretch of sea, which lies to the west of these islands. What name do we give to **a very large body of water like this?** An **ocean.**

Do you remember the particular name of this one? It is called the **Atlantic Ocean.**

Point out on the globe, and explain that, in reality, the whole of the water on the earth forms one continuous body, stretching in all directions. It is really **one immense ocean.**

2. *Tell that, for convenience, we give this immense body of water* **different names in different parts of the earth,** *and hence this one is known as the* **Atlantic Ocean.**

Show on the globe that this great ocean **lies between us**

and America—*that Europe and Africa are on one side of it, and America on the other.*

Tell that the distance from England to America, across the Atlantic, is **about 3000 miles,** *and that* **powerful steamers** *make the voyage, from one side to the other, in* **about a week.**

The Pacific Ocean.—

1. *Turn now to the immense body of water which lies to the west of America, and show on the globe that it stretches from the shores of that continent to those of Asia.*

Give its name—**Pacific Ocean**—*and tell that it is* **the largest of all the oceans.**

Notice how it is **dotted with islands** *in many parts.*

What name do we give to a sea which is dotted with islands? An **archipelago.**

Point out the clusters of islands in the South Pacific, and tell that we call this **the Pacific Archipelago.**

2. *Tell that some of these are* **volcanic islands,** *but most of them are formed of* **coral rock,** *and we call them* **coral islands.**

These coral islands have been made by countless millions of **curious little sponge-like animals** that live in the sea, some of them **no larger than the head of a pin.**

They make, from the food which they find in the sea, a hard, bony skeleton for their body. The rock is nothing more than **a mass of the skeletons of the dead coral-workers.** *Show a specimen of coral here.*

3. *These coral animals are often incorrectly spoken of as insects.* **They are not insects** *in any sense of the word.* They have the appearance of **tiny, jelly-like bodies;** they are **fixed to the spot** where they live; and can **never move away from it.** They are properly called **polyps.**

The Indian Ocean.—

Point this out next, and show the reason for its name.

Notice that it lies **entirely within the Torrid Zone.** *The lands near it are* **the hottest countries in the world.**

The Arctic Ocean.—

Call attention to the North Pole, and the sea all round it. This is another of the oceans. Tell its name, and show why it is so called from **Arktos, the Great Bear.** *The children will, no doubt, remember the name of this important northern constellation.*

Remind them of what they learned in the last lesson about this region, and lead them to describe it as a region of ice and snow. Tell that for many months in the year **even the sea itself,** *in this Arctic region,* **is everywhere frozen over.**

The Antarctic Ocean.—

Point this out. Show that it lies round the South Pole, **opposite the Arctic Ocean.** *Hence its name.* **Anti** *means* **opposite.** *Compare* **antipodes.**

Call upon the children to tell, from all they now know, what they would expect to find here.

Summary of the Lesson

1. A continent is a large extent of land, which contains a great many different countries.

2. The British Islands are part of the Continent of Europe. France, Spain, Germany, are countries in Europe.

3. Asia is the largest of the continents. India and China are countries in Asia.

4. Africa is the home of the black people. Nearly the whole of this continent is in the Torrid Zone.

5. America is the home of the Red Indians; but most of the people who live there now are white people like ourselves.

6. Australia is another great continent; and the whole of it belongs to England.

7. There are five great oceans—the Atlantic, the Pacific, the Indian, the Arctic, and the Antarctic Oceans.

Lesson XXXII

MEANING AND USES OF GEOGRAPHY (A CHAT)

Brown's Picture of "A Sea-Port" will be useful.

I. WHAT GEOGRAPHY IS

TO-DAY I want you to think carefully about the kind of things you have been learning in these lessons from the very first, and you will see that, step by step, they have helped you to find out something new about this wonderful world in which we live.

1. In our very early lessons, a long while ago, you remember, we began by taking notice of **the sky, the air** around us, **the sun, the clouds**, and so on. Then we learned what the clouds are made of, and why they send us rain. **We watched the rain fall**, and saw it either **collect in puddles** in the roadway, or else **flow away in streams** down the gutters; and we also noticed that some of it **soaked into the ground**, and some became **changed into vapour** and disappeared in the air.

2. Why did we take so much trouble to watch the rain? Because we can learn from the rain exactly **how rivers are formed.**

Quite right; and then after having found out what rivers really are, we followed them **from their source to the sea**, learning all the time new things about **hills and valleys, plains** and **mountains, capes, islands, bays, straits**, and so forth.

3. We learned, not only to understand the nature and appearance of these different parts of the land and water, but also **how to find them out on a map**, and **how to make a map of them** for ourselves.

Then we began to learn something about our own country—England—and the lands and seas near it; and last of all we had a peep at some of the lands and seas a long way off.

4. We have also learned a great many things about the earth itself.

It is not flat as it seems to be; it is **a great round ball.**

It is not still as it seems to be; it is **constantly spinning round,** and **travelling onward** at the same time.

All parts of the earth are not like ours. There are **cold icy regions,** and there are others **where the sun scorches like fire.**

All this, and much more besides, we have learned here in our lessons about the world we live in, and there is still much, very much more to learn.

5. Now we have a name for all this knowledge about the earth, just as we have names for every other kind of knowledge. We call it **geography.**

It is a long word, and it is not an English word. We have borrowed it from the old Greek language. But it means simply this—**earth-knowledge,** or **knowledge about the world we live in.**

II. How Geography is Learned

1. *Picture to the children the people who lived here, on the very spot perhaps where their school now stands, in the distant ages, ever so long ago. Tell that there were no large towns and villages in the land then; that the people were few in number,*

and scattered over the country; and that **they seldom left the places where they were born.**

They knew nothing of the world outside their own particular spot, and they dared not move far away from it **for fear of losing themselves.**

2. *Point out that away from their own district these people would be in the position of a lost child wandering through a wood, dreading they knew not what, and* **without the least knowledge as to where they were, or which way to turn.** *They would get no assistance from those they might chance to meet, because they, like themselves, would know nothing beyond their own little spot.*

What they all wanted was **earth-knowledge—geography.** How did they get it? Let us see.

3. *Imagine one or two such people of a bolder and more adventurous turn than the rest, setting out from their homes to seek their fortunes. They would be familiar, of course, with* **the sun** *and* **the stars,** *and these would be* **their only guides by day, and by night.**

Picture them making their way cautiously at first, like men groping in the dark, **through dense forests, over mountains, across open valleys** *and* **wide plains,** *and* **along the banks of some river,** *till it led them at last* **to the sea.**

This same river may have flowed by the very doors of their old home; but so long as they remained fixed to that one spot they knew nothing of it—where it came from, or what became of it at last.

What they wanted was **earth-knowledge—geography.** How did they get it? **They got it by travelling.**

4. *Point out that, wherever these people went over the land, they were* **adding to their store of earth-knowledge—** *they were* **learning more and more geography;** *and then imagine them after a time, burning with a desire to learn*

something about the great sea which stretched out in front of them, and to find out what was beyond it **on the other side of that horizon which bounded their view.**

It was this desire which **led them to make boats,** and then, after the first natural fear of the sea was over, they began to **venture farther and farther from the shore,** until at last they found what till then had been an **unknown land on the other side.**

5. *Picture them landing on those* **strange shores,** *and finding there* **strange people,** *speaking a* **strange language,** *and having* **strange manners and customs.** All this would be **fresh earth-knowledge—another lesson in geography** for them—something more for them to tell their stay-at-home friends on their return.

6. *Show that in this way* **these early sailors were the first teachers of geography**—*that they learned it by travelling about from place to place, and then brought home the news of all they had seen and learned for the benefit of the rest.*

So it has been ever since. **Our earth-knowledge,** or **geography, has been learned** first of all **by men who have travelled** about the world.

Lead the children to think of those very early sailors in their **frail, crazy, little boats,** *with nothing to guide them* **but the sun by day** *and* **the stars by night.**

They dared not venture very far out of sight of the land in those days.

Lead them also to tell how all this was altered when somebody found out **that a magnet,** *if free to move,* **constantly points to the north,** *for this knowledge helped them* **to make and use the mariners' compass.**

With the compass as their guide the sailors no longer dreaded the sea. They sailed away for months and even years, and during most of that time they were **entirely out of sight of any land.**

7. It was the brave and clever sailor, **Columbus,** who,

about 400 years ago, sailed away to the west into the great unknown ocean, the Atlantic, and found out (or discovered as we say) a new land, which, till then, no one had ever heard of—**the great continent of America,** or **the New World** as we sometimes call it.

It has been brave and clever sailors who, from time to time, have discovered other new lands in all parts of the world, and who first taught us all we know about them.

8. It was **a brave and clever sailor** who, by sailing away in one constant direction, and returning home from the opposite direction, **first proved to everybody that the earth must be a great round ball.**

III. Uses of Geography

1. After all we have said, what do you think is the chief use of geography? It helps people **to find their way about in the world.**

Yes, it does, and I will now show you what an important thing that is to everybody.

2. *Carry the children back to their last two lessons, and lead them to think of the hot and cold lands in different parts of the earth.*

Tell that when we speak of these lands we say they have **a hot climate,** *or* **a cold climate;** *and explain that by the climate of a country we mean* **the condition of the sky and the air above it.**

3. *Lead them to tell, from their own experience and observation, that some plants live and grow here out in the open air all through the year, but that* **others have to be kept in glass houses,** *because it is warmer there than in the open air.*

Elicit that such plants would die if they were planted out in the garden; and then tell that **in warm lands those same plants grow in the open air,** *just as others do with us.*

4. Oranges and lemons, figs, dates, bananas, and many other kinds of fruits **would not grow in our climate**, but in the sunny lands of the south they are to be seen **growing in the open air**, just as apples, pears, plums, and cherries grow with us.

This is true not merely of fruits but of every plant that grows. Each different climate **produces its own particular kind of plants**, which would die if they were removed to another climate. In one case they would be **pinched up and withered with the cold**, in another **the sun would scorch them up**, and so kill them in that way.

5. Now what does all this tell us? If you could go with me some day to one of our great seaport towns, and watch the ships unloading their cargoes in the docks, you would understand it all at a glance.

You would learn that these ships bring over from lands across the sea **hundreds of things, which form a very large part of our everyday food and clothing.** They have to be brought to us in ships, **because the plants on which they grow would not live in our climate.**

Give a few examples of some of these common, everyday articles of use, such as sugar, coffee, tea, cocoa, raisins, currants, and so on; and point out that, **if men had not learned enough geography to help them to find their way to foreign lands,** *we could never have had any of these things.*

6. *Turn next to* **bread**—*the most common article of our daily food. Elicit that* **bread is made from the flour of wheat**; *and then explain that, as England is a small country crowded with people,* **it would be impossible to grow enough wheat here to feed everbody.**

By far the greater part of the wheat for our daily bread **has to be brought in ships from other lands.** Therefore, **without the knowledge of geography, our**

people would **starve**—there would not be enough bread in the country to feed them.

7. *Take* **cotton** *next as an article of clothing; tell what it is and where it grows.* **It must be brought to us across the sea.**

8. *Pass on next to the animal world, and point out that certain animals are formed to live in certain climates.* **Each animal has its particular home,** *and in its natural state it never leaves that home. Give a few examples.*

Speak briefly of the important part which the animal world plays in providing us with articles of use—both for food and clothing. **Many of these things have to be brought across the sea.**

9. *Lastly, show that it is equally true with regard to minerals.* **One land gives us gold,** *another* **silver,** *another* **copper,** *and so on, but* **without geography we should never have known where to find these things.**

10. Through the knowledge of geography we are able to go to other lands, and get from them **hundreds of things which we want for our use**; while, at the same time, we take in the ships, for the use of the people there, things of which they stand equally in need.

This exchange of one kind of article for another is known as **trade** or **commerce**.

It feeds and clothes everybody; it **gives work to our workers,** and **joins the people of far distant lands into a close bond of brotherhood,** for their mutual good—and **geography does it all.**

Summary of the Lesson

1. Geography is earth-knowledge—knowledge about the world we live in.

2. Our early sailors were the first teachers of geography.

3. The knowledge of geography helps men to find their way in ships from one country to another.

4. Ships bring us, for our daily use, hundreds of things from other lands, which we could not have without this knowledge of geography.

5. The same ships take to the people in distant lands things which they require for their use.

6. This exchange of one kind of article for another is known as trade or commerce.

7. There could be no commerce without a knowledge of geography.

THE END

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WORKS BY VINCENT T. MURCHÉ

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